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THE HOME STUDY OF CORAL REEFS

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Introduction. If a geographer or a geologist, who has never seen any coral reefs, nevertheless has occasion to give some account of their origin, two courses are open to him. He may simply quote, without expressing his own opinion, the observations and opinions of those who have seen coral reefs; or he may attempt, after a more or less critical study of the reports of original observers, to form an opinion of his own. The first course is apparently easy to follow, but in this problem it would give little satisfaction because the opinions of the original observers are diverse and contradictory. The second course is not easy to follow but it is well worth attempting. The chief difficulty about it is that there is no generally adopted, standardized method of scientific investigation, in accord with which various original observers of coral reefs have conducted their studies, and by comparison with which the sufficiency of their studies and the trustworthiness of their results can be measured. Each stay-at-home inquirer must therefore, before he can independently form an opinion regarding the more important current views on coral reefs, more or less consciously establish for himself a generalized method of investigation, with which the investigations published by others may be compared. In establishing such a method he must select its essential steps from various examples of approved studies previously accomplished; he must test its efficiency by applying it in problems of his own, and with increasing experience he must revise and extend it; he should eventually

arrange the successive steps of the generalized and well-reasoned method in such order that it shall be of general application in problems of physical geology and physical geography.

The generalized method of investigation outlined below has come to my own knowledge not as a method already formulated in the study of logic, although it has long been familiar to logicians; but in the gradual way just indicated, and largely from the writings of Gilbert and of Chamberlin. It seems to be used by some students of earth science, but not by all; yet it would appear to be essential in the solution of problems that involve the discovery of the past origin of the earth's present features. The method has repeatedly been helpful in guiding various studies of my own, and I have come to feel much confidence in its value. Hence it is with this generalized method that it is now proposed, for my own satisfaction and for the information of those who are interested in the problem here considered, to compare several investigations of coral reefs, in order to see how far they meet the requirements of systematized procedure, and how far they may therefore be accepted as convincing to a stay-at-home inquirer, as well as to those who conducted them.

This plan of discussion is more novel in appearance than in reality; for any home student, who does not merely accept theoretical conclusions on the authority of traveled observers, must more or less consciously examine the methods by which the conclusions have been reached, and in so doing he must reject conclusions that are not reached by methods satisfactory to himself; but while he commonly announces, in his teaching or his writing, the acceptance or the rejection of the conclusions reached by others, his ideas as to the fundamental requirements of a thoroughly satisfactory method of investigation and of the degree of approach to such requirements made by the investigations that he has been studying are often passed over in silence. It is here proposed to state them explicitly.

It is assumed that the home student, who has never seen any coral reefs, wishes not merely to know the present forms, dimensions and appearance of these extraordinary structures, but also to understand their origin. It must therefore be recognized that observation alone will not suffice to lead to the desired end, for the origin of coral reefs involves the action of unobservable processes during irrecoverable past time. However fully one may believe that certain processes were in their time and place quite as truly facts as are any observable processes of to-day, it is evident that observation

alone will not discover them: they can be discovered only by seeing and thinking—by observing and theorizing. Hence the old adage: "Go and see," should in studying problematic phenomena like coral reefs, be replaced with the newer adage: "See and think."

Chief Steps of an Investigation. The chief steps to be taken in the attempt to decipher the past origin of an existing earth-feature may be outlined in the following order: observation, comparison, generalization, inquiry, invention, deduction, confrontation, revision, judgment; or, to state them somewhat more fully: the determination of visible, accessible, existing facts by direct observation; the establishment of generalizations by the inductive comparison of similar facts; then, prompted by a spirit of wonder and inquiry regarding the seen facts and guided by previously acquired pertinent knowledge, the invention of as many provisional schemes, or "working hypotheses," as possible, each embodying an imaginary outline process, which, if mentally extended and traced through its imagined sequence of changes in past time, may lead to concepts that are the counterparts of the present facts, and thus constitute what is called their "explanation"; next, the deduction, consistently with established principles, of all the possible consequences from each outline scheme or working hypothesis, in the expectation that, while some of the consequences will be the counterparts of the facts already observed, others may be the counterparts of facts still to be observed, the discovery of which may thus be intelligently directed; further, the confrontation of the various sets of consequences deduced from each hypothesis with the appropriate facts, in order to measure the closeness of their agreement; then the revision of the whole process, including the observational search for previously unseen facts, of which the possible existence is now suggested by the consequences deduced from the several working hypotheses, the strengthening of weak generalizations by larger induction, the invention if necessary of new hypotheses or the modification of the previously invented hypotheses in any way that will enable any one of them better to account for the growing store of facts and generalizations, the pursuit of new deductions previously overlooked but now demanded by new facts, and the renewed confrontation of deduced consequences and observed facts; finally the impartial judgment of the sufficiency with which the consequences of the most successful hypothesis can account for the total collection of facts, and of the failure of the other hypotheses.

Let it be recognized, however, that the order of making all these

steps during an actual investigation is usually very irregular, with many advances and returns and with many running leaps as well as slow paces. The order here given is simply a logical arrangement, adopted as an aid in systematic presentation after the investigation is well advanced or completed. Be it further recognized that experimentation, which is so important an aid and supplement to seeing and thinking in many problems of physical science, is here intentionally omitted, because, in most problems of geology and geography, experiments have rather an illustrative than a demonstrative value. Finally, let no one expect that young students can, before their minds are disciplined, make the succession of steps here outlined: that would be like expecting a baby to walk alone, before its bones are strengthened. A bright young student of eighteen or twenty may, to be sure, understand each step, as it is explained to him; but he will do well if, at twenty-three or twenty-five, he can make all the steps unaided: much training and some maturity are needed for the correct and independent prosecution of a thorough-going investigation through all its many parts. It is my personal belief that a student's capacity to carry out a thorough investigation independently is not so well developed by the abstract study of formal logic, in which the necessary mental processes are described and defined but not performed, as by the concrete study of scientific problems, in which the method of reaching results, and not chiefly the results reached, is explicitly set forth, with practical exercises in graded problems; in short, by what Gilbert has called "the inculcation of scientific method by example."

The Danger of Error. All the mental processes above named may involve error, from observation at the beginning to judgment at the end. The observation of facts may be inaccurate, either from carelessness or incompetence; and it may be misleading by the unwitting introduction of inference along with fact. For example, the term delta ought not to be used in a purely observational record regarding a flat lowland at a river mouth, because delta implies not only such a certain kind of land form, but also the inferred action of unobservable past processes in producing it. It may be that the inference here implied is well grounded and that the explanatory term, delta, is fully justified; nevertheless it does not represent mere observation of visible facts. Indeed few scientific observers are so careful in this matter as was a distinguished Senator from Iowa, who on hearing a friend remark, "Those sheep

have been sheared lately," said: "Well, I should hardly care to assert so much as that, but they certainly do look as if they had been sheared on this side."

Again, the comparison and generalization of groups of apparently similar facts may be premature or hasty or unwarranted, if the facts thus brought together are scanty, or are not really homologous; this would be the case if the valleys of the Cévennes were grouped with the glens of the Scottish Highlands, for the first have their tributary valleys entering the main valleys at accordant levels, while the second do not; or if the branching embayments of Devonshire and Cornwall were grouped with the fiords of Norway, for the branches of the embayments gradually increase in depth to the embayment axis, while the branches of the fiords do not. Further, the spirit of inquiry may be repressed, as if it should not be given liberty until all observational work is finished; and under this belief Darwin seems to have been censured by some other students of coral reefs, because he began to wonder about these curious forms and actually invented his theory of their origin while he was in South America, where he had been led "to reflect much on the effects of subsidence," before he had ever seen a true coral reef!

The invention of hypotheses may be badly grounded on an incorrect or an imperfect knowledge of pertinent principles, as when a shallow synclinal depression was suggested to account for the southwest course of the Severn, in ignorance of the retrogressive development of such rivers by headward erosion along belts of weak structures; or an invented hypothesis may be wrongly constructed on an inadmissible combination of processes, as when it is sought to explain the hanging lateral valleys of the Alps by the greater activity of normal erosion in the wide-open main valleys; or invention may sluggishly cease when only one hypothesis has been invented, although evidently enough the first one may not be the true one, as when it was suggested that atolls were built on submerged crater ruins. The deduction of consequences may be illogical, as when it is inferred that the rivers of an uplifted and gently inclined peneplain will be new-formed and will take directions consequent upon its inclination, whereas they will really persist in their former courses although revived to new activity; or incomplete, as when, in the discussion of Alpine lakes, fifty years ago, the geographers and geologists who opposed glacial erosion, did not perceive that lakes formed by the warping of normal val-

leys must have lateral embayments, and left the deduction of this essential and highly significant consequence of their theory to a clear-minded zoologist. Indeed, deduction and all the other remaining processes may be unwisely omitted by an inventor who is so charmed with the apparent success of his first-formed outline of an hypothesis that he at once accepts it, without demanding that it shall do anything more than explain the facts that it was made to explain. The confrontation of deduced consequences with observed facts may be so unfairly forced as to bring about apparent agreements where none really exist. The revision of all the preceding steps with the intention of making up omissions, correcting errors, and amending inventions, may be opposed by too rigid a habit of mind, or unduly hurried by an impatient desire to finish an investigation. Final judgment may be warped by prejudice or preference, or prematurely announced in the wish to settle upon a decision. The path of the investigator is beset with dangers!

Safeguards against Errors. The danger of making errors in any of the steps here catalogued may be lessened by a recognition of their nature, by practice in correctly conducting the successive steps of an investigation, and by the conscious use of appropriate safeguards. Observation becomes more trustworthy if carefully made by a trained, keen-eyed observer, who consciously strives to exclude prepossession and inference from his examination of facts, and who scrupulously keeps his record of facts separate from his invention of explanations. Comparisons and generalizations will be properly formulated by an experienced and conscientious investigator, who patiently assures himself of the essential similarity of the facts that he classes together, who prudently refrains from generalizing on too narrow a basis, and who impartially averages the values of common elements; it was a great merit in A. Agassiz' studies of coral reefs that he insisted on their many diversities, and demanded a large collection of facts before generalizing upon them. The spirit of inquiry ought never to be stifled, although its fancies ought to be carefully held apart from the observation and the generalization of facts. Darwin's spirit of inquiry and invention was ever active, for he wrote in regard to hypotheses: "I cannot resist forming one on every subject" (Life and Letters, Vol. I, p. 103). Perhaps his word, resist, as here used, reflects the objection to lively inquiry and fertile invention that is sometimes expressed by would-be cautious investigators; but they should read Playfair, who over a hundred years ago wrote: "It would, however, be to

argue strangely to say, that we must wait till these discoveries are made before we begin any theoretical reasoning . . . . . Such conduct would not be caution, but timidity, and an excess of prudence fatal to all philosophical inquiry'' (Illustrations of the Huttonian Theory, 1802, p. 524).

Invention is peculiar in being largely an unconscious process that suddenly awakes, ejaculating ''Eureka.'' Darwin said regarding one of his problems: ''I can remember the very spot in the road, whilst in my carriage, when to my joy the solution occurred to me'' (Life and Letters, Vol. I, p. 84). But invention should not cease with its first product; it should be spurred on to produce several hypotheses, not merely because the first one may not be right, but even more in order to prevent the growth of overfondness for the first-born by insisting on a fair treatment for its younger sisters. It is evident that invention will be more successful in a mind that is well stored with previously acquired pertinent information, ingenious in arranging old knowledge in new combinations, and fertile in bringing forth many diverse possibilities. Deduction, unlike invention in being more largely a conscious process, is like it in depending to a great measure on wide acquaintance with pertinent principles, and on a logical capacity to work out sequences from the interaction of various processes under diverse conditions; it must be perseveringly pursued to the detailed definition of many peculiar consequences for every invented hypothesis, and the contrasted consequences of rival hypotheses should be searched out with especial care. The later part of Playfair's paragraph, cited above, touches this case: ''The truth, indeed, is, that in physical inquiries, the work of theory and observation must go hand in hand, and ought to be carried on at the same time, more especially if the matter is very complicated, for there the clue of theory is necessary to direct the observer.''

Confrontation of the sets of consequences deduced from rival hypotheses with the facts determined by observation must be deliberate, unconstrained and searching, in order to select from among the various competing hypotheses that one of which the consequences are the best counterparts of the facts. Especial attention should be paid to examples of facts for which no matching consequences have been deduced, and to consequences for which no matching facts have been observed. Revision cannot be properly performed without open-mindedness, and this mental quality should lead to the exclusion of such words as ''grant,'' ''admit,'' and ''con-

cede" from such investigations as are here discussed as carefully as they are excluded from geometrical demonstration. Revision should moreover be applied to every stage of progress; observation should be resumed to see if the mates of deduced but unmatched consequences really do exist; comparison and generalization should be renewed whenever new facts are found; invented hypotheses must be modified wherever modification will lead to more successful confrontation, and therefore every invented hypothesis should be conceived as an elastic, not as a rigid scheme; deduction must be repeated to see if the mates of observed but unmatched facts may be fairly found. Darwin wrote: "I have steadily endeavored to keep my mind free, so as to give up any hypothesis, however much beloved . . . . . as soon as facts are shown to be opposed to it. Indeed I have had no choice but to act in this manner, for with the exception of the Coral Reefs, I cannot remember a single first-formed hypothesis, which had not after a time to be given up or greatly modified" (Life and Letters, Vol. I, pp. 103, 104). Judgment calls for fair-mindedness, with no shadow of preference or of special pleading; it demands also a practiced willingness to suspend decision in doubtful cases, and to reverse an early decision that is later found to be wrong. When Lyell learned Darwin's theory of coral reefs, he wrote to a friend: "I must give up my volcanic crater theory forever, though it cost me a pang at first, for it accounted for so much . . . . . all went so well with the notion of submerged, crateriform and conical volcanoes . . . . Yet in spite of this the whole theory is knocked on the head, and the annular shape and central lagoon have nothing to do with volcanoes, nor even with a crateriform bottom" (Life of Sir Charles Lyell, Vol. II, p. 12).

Indeed if proficiency in every part of the mental technique of scientific investigation is best gained by exercise of the appropriate mental faculties, it may be contended that, just as it is surely advisable for a teacher not to inform any of his students so fully that they have no chance to exercise the faculty and to experience the joy of inventing solutions for their problems, so it is *almost* worth while for a teacher to lead his more advanced students to accept for a time an erroneous theory, in order that they may later go through the profitable experience—even "though it cost a pang"—of being logically compelled to give it up when it is, as Lyell said, "knocked on the head"; for the probability is great that in their later life they will repeatedly have need to use the mental mobility

thus acquired. The maintenance of a suspended judgment also requires practice; the return to the unsettled state of mind that suspended judgment involves is not easy even for the best disciplined investigator, especially if he has enjoyed for some time, perhaps for many years, the contentment of a settled conviction; but a striking example of such return is found in the change from a glowing commendation of Darwin's theory of coral reefs written by Sir A. Geikie in 1882 to an explicit uncertainty about it in 1885. The commendation states that Darwin's explanation of coral reefs is "a theory which for simplicity and grandeur strikes every reader with astonishment. It is pleasant, after the lapse of many years, to recall the delight with which one first read the *Coral Reefs*, how one watched the facts being marshaled into their places, nothing being ignored or passed lightly over; and how, step by step, one was led to the grand conclusion of wide oceanic subsidence. No more admirable example of scientific method was ever given to the world" (Charles Darwin: Nature Series, 1882, p. 17). The subsequent uncertainty seems to have been occasioned by the announcement of alternative theories and reads as follows: "That the wide-spread oceanic subsidence demanded by Darwin's theory cannot be demonstrated by coral reefs must now, I think, be conceded" (Textbook of Geology, 1885, p. 454). The same competent critic wrote some years afterwards regarding the theory of subsidence: "It has been to myself and to many other geologists a matter of keen regret that this brilliant generalization of the great naturalist has been deprived of the wide application which for many years we attributed to it." (Charles Darwin as Geologist, 1909, p. 36).

The Nature of Proof. It may be fairly remarked that the successive steps of an investigation, with their attendant dangers and their reassuring safeguards as here outlined, are all familiar matters, because they have been duly set forth in text-books on logic and elsewhere. They are indeed hardly more than truisms to investigators who are fully familiar with them, and if all observers of coral reefs had been trained to full familiarity with them, there would be no need for a home-student to undertake a comparison of actual methods of investigation with a generalized method, such as is here proposed. But, singularly enough, many observers of coral reefs have not, if one may judge by their published articles, been familiar with the generalized method here set forth—or if they have, their work does not show it, for essential steps are omitted.

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A stay-at-home inquirer must therefore often remain unsatisfied with their discussions; he can accept an observer's conclusions only if the observer's investigation is thoroughly carried through all the mental steps from observation at the beginning to proof at the end. What, then, is the nature of the proof which must be demanded before a conclusion should be regarded as demonstrated?

Adverse judgment must be rendered against an hypothesis when its consequences are contradicted by the facts. Judgment must be suspended when an hypothesis does not account for all the facts, or when two or more hypotheses succeed equally well in accounting for them. Favorable judgment must be rendered when, the facts to be accounted for being numerous, wide-spread, varied and peculiar, the apparently successful hypothesis involves only well ascertained principles, when its deduced consequences are even more numerous and peculiar than the facts, when the first confrontation of the consequences with the appropriate facts leads to repeated and striking agreements whereby the facts are seen to possess reasonable and orderly relations not noticed before, when continued observation and confrontation discovers new facts for which no matching consequences have been deduced but for which good matches are found when the invented hypothesis is properly modified or the deduction of consequences is carefully revised, when still further confrontation shows certain consequences for which no matching facts have been observed but for which good matches are found of their predicted kind and in their predicted place after observation, thus guided, is repeated; and when all these tests are successfully applied by many observers in various localities through a long period of time. The four chief lines of proofs of a theory may be briefly named: replacement of unmeaning disorder by reasonable system, capacity to explain new facts, prediction of unnoticed facts, and survival after long-continued, wide-spread scrutiny. Each line of proof is good, but all ought to be successful, before a theory deserves full confidence. After all these requirements have been completely fulfilled the sane mind refuses to remain in doubt; it adopts the successful hypothesis, which thus takes the rank of an established theory, and even though the theory be only a figment of the imagination it is then regarded as supplying the true counterparts of the invisible realities inscrutably hidden in underground structures or irrecoverably lost in past time.

The Class of Readers here addressed. The explicit statement of all these truisms involves delay in reaching our main subject, and

indeed the impatient reader may regard so elaborate an introduction as unnecessary and hasten on to the discussion of the theories of coral reefs, without stopping so long in preparing for the discussion. Let it therefore be explained that the outline of this essay was prepared as an address to university audiences, and that on its delivery at Oxford and Cambridge Universities in November, 1913, the introduction seemed as novel to the groups of British scientific students there gathered as it had previously seemed to audiences of American students at Harvard, Columbia, Ohio and Michigan Universities. The reason for this is probably to be found partly in the responsibility felt by teachers to give a large body of information to their students, so that little time is allowed for the presentation of the methods by which the information is reached; and partly in the difficulty of securing even from graduate students the closeness and the duration of mental attention necessary for the real appreciation of scientific method. This essay is therefore addressed, not to university students in general, but to the more earnest students among them, as well as to scientific readers in general, who have the ambition to become critical as to the sufficiency of scientific investigations, who are interested in the origin of coral reefs as well as in many other problems, and who may wish to form, each for himself, a carefully systematized method of procedure.

Facts of Observation and Facts of Inference. Although this essay is concerned largely with the existing features of coral reefs, it involves the consideration of past processes, and it is, to that extent, geological. Hence it must be noted that geological science is more largely made up of the imagined counterparts of invisible past realities than of observed present realities; indeed most geologists do not stop to distinguish between what may for them be called "facts of inference," and "facts of observation." As examples of "facts of inference," regarding which discussion has ceased because it seems unprofitable, we may mention: the extension of strata through a hill between outcrops traced around the hill sides; the gradual deposition of sedimentary strata, part by part; the successive deposition of superposed strata; the lapse of unrecorded time at an unconformity; the organic origin of fossils; the movement of displacement on faults; the former fluidity of prehistoric lava flows; and so on through a long list. All of these inferences have been so abundantly tested that they are accepted as verities.

A few lines may be allowed in order to recall the fundamental

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assumptions upon which all such investigations as are here considered must be based. Chief among these is the continuity of time and the persistence of the order of nature through the remote past. No conclusions regarding past processes are any safer than these unprovable assumptions; but the assumptions and the conclusions are so consistently confirmed by all facts of observation, that, in accordance with the teachings of the school of philosophy lately called pragmatic, they are accepted as true; that is, the entire scheme of earth-science thus built up, when tried by many men in many places, by many tests at many times, is found to "work"; therefore the elements of the scheme are believed to be the counterparts of the invisible, past realities of the world.

Facts Concerning Coral Reefs to be Accounted for. The facts of observation and the associated generalizations, which have to be accounted for by a theory of coral reefs, are chiefly: the distribution of reefs—this important matter is summarized in an admirable series of recent charts, "Cartes des bancs et récifs de coraux," by Joubin (4 sheets, 1:10,000,000, Paris, 1912); the surface forms and structures of those masses known as uplifted reefs, fringing reefs, barrier reefs, and atolls, and the relation in which the uplifted, fringing and barrier reefs stand to the enclosed islands or to the neighboring mainland; the occurrence of living corals chiefly on the outer side of the reefs above depths of twenty or twenty-five fathoms; the shallow lagoons enclosed by barrier reefs and atolls and the nature of their bottom deposits. Among the "facts of inference" which will be here accepted without discussion are: the organic origin of the under-mass of coral reefs, the great thickness of which has been proved in a few cases by borings; the volcanic origin of the mountainous central islands within many fringing and barrier reefs, regarding which an excellent though brief summary is given with abundant references to detailed articles, in P. Marshall's "Oceania" (being Part 5, Sect. 1, Vol. 7 of Steinmann-Wilckens' Handbuch der regionalen Geologie, Heidelberg, 1912); and the geologically modern occurrence of a "glacial period." Pertinent items of related knowledge concerning the colonization of new volcanic islands or of uplifted shore lines by floating coral larvæ, the manner of growth of corals and of other organisms found on the reefs, in the lagoons, and in the sea around them, and the limiting depths and temperatures at which these organisms live; the formation of oölitic, calcareous deposits and the possible solution of such deposits by sea water; the effects of

winds, waves and currents on reefs; the characteristic changes of form produced by normal and by marine erosion of volcanic islands; the changes brought about by movements of elevation and subsidence, either in the sea itself or in the sea floor and the islands that rise from it; and the evolution of insular faunas and floras.

Theories of Coral Reefs. The more important theories of coral reefs, arranged in order from the simplest to the most complicated, are listed below. For conciseness of statement, only oceanic reefs are here considered; explicit mention is seldom made of reefs on continental borders, for such cases may be treated as large islands.

1. The formation of atolls on the rims of slightly submerged volcanic craters.

2. The upbuilding of a still-standing submarine bank to a moderate depth, by non-coral organic deposits, and then to the surface by corals and associated organisms, thus forming an atoll, which may afterwards be enlarged by outward growth of the reef, on its own talus, while the lagoon is enlarged by solution.

3. The establishment of a fringing reef around a pre-existent still-standing island, the conversion of the fringing reef into a barrier reef by growth on the outside and solution on the inside, and the conversion of the expanding barrier reef into an atoll by the wearing away of the central island.

4. The abrasion of a bench by marine action on a still-standing, pre-existent island, and the establishment of a veneering barrier reef on the outer rim of the platform.

5. The complete truncation of a pre-existent island by marine abrasion, and the establishment of a veneering atoll on its outer rim.

6. Slow subsidence of a pre-existent island, and the gradual transformation of its fringing reef by slow upgrowth into a barrier reef around the diminished central island, and into an atoll over the vanished central island.

7. The subaerial degradation or the marine abrasion of an uplifted reef, or mass of marine limestone, to a platform close to or slightly below sea-level and the establishment of reef-building corals around the outer border of the platform, thus producing a barrier reef or an atoll, according as the uplifted mass had or had not a harder non-calcareous core.

8. Abrasion of a platform on pre-existent, still-standing islands and reefs by the sea while it stood at a lower level during the glacial period, when much ocean water was withdrawn and stored

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as ice on the lands, and when the corals of most reefs were killed by lower temperature; followed by upgrowth of barrier reefs and atolls on the border of the abraded platform during the opening of the milder post-glacial period and the restoration of the withdrawn water to the ocean.

These theories will now be considered in order as above arranged:

1. *Atolls Built on Submerged Volcanic Craters.* It was long ago suggested that atolls were built up from the rims of submerged volcanic craters. This theory first came to be regarded as improbable because it postulated the occurrence of many craters of unusual size. No other special consequences were deduced from it, as a means of testing its verity. When it was later learned that reef-building corals could not grow below moderate depths, the theory demanded the further postulate that numerous craters of unusual size should be built up nearly but not quite to the sea surface; and the theory then broke down because of the improbable conditions that it demanded. As a general explanation it was given up "with a pang" by Lyell; it was recognized by Darwin as possible in special cases; A. Agassiz found what he took to be actual examples of atolls thus formed in the Fiji group.[1]

2. *Atolls Formed by Upward Growth on Still-standing Banks.*[2] The next simplest theory of coral reefs is that in which atolls are supposed to be built up from a submarine base or bank, such as a volcanic cone that rises part way to the sea surface from a still-standing ocean bed. As long as the bank does not reach near enough the surface for colonization by corals, it may be built up to the requisite shallowness by other organisms, after which the corals will build their reefs to the surface, and then enlarge the resulting atoll by outward growth on a foundation of their own talus, while the lagoon is enlarged by removal of the inner border of the reef by solution. Various observers have called attention to the action of the dominant winds and currents, in determining the pattern of an atoll by drifting the coral sand around from the windward face to the curved extremities of the reef; but as this action has effect on reefs of whatever origin, it need not be further considered here.

This is evidently an easily conceivable theory, so far as its sev-

[1] The Islands and Coral Reefs of Fiji, *Bull. Mus. Comp. Zool., Harvard Coll.*, Vol. 33, 1899, p. 40.

[2] Sir J. Murray: On the Structure and Origin of Coral Reefs and Islands, *Proc. Roy. Soc. Edinb.*, Vol. 9, 1880, pp. 505-518.

eral postulates are concerned, and its consequences, as far as they are announced, seem to be correctly deduced; but the main postulate of the theory—a still-standing ocean bed—is shown to be improbable by the occurrence of many islands bearing coral reefs at various unequal heights above present sea-level, for this proves that the ocean bed on which the islands stand has not remained fixed but has been unequally uplifted; and further by the occurrence of many embayed islands, in which the embayments are so large as to demonstrate subsidence and not merely a change of sea-level during the glacial period, and this indicates that the ocean bed on which such islands stand has been depressed. Is it indeed not true that all islands, of which the geological history through Tertiary and later time has been deciphered, show many changes of level? The island of Sumbava, studied by J. Elbert, is too near a continent to be taken as a type of an oceanic island, but it certainly seems to have suffered repeated movements of elevation and depression since Miocene time.[3]

Furthermore, certain essential consequences of this theory as to the submarine structure of atolls have not been emphasized by its authors; for example, the moderate thickness of the central, horizontally bedded lagoon limestones, in so far as they are of shallow-water accumulation, and the great volume of peripheral talus deposits with which the central beds should be surrounded in large, old atolls. Brief mention, or the mere implication of such consequences, was perhaps regarded as sufficient because they are so manifest, or perhaps because the corresponding facts are inaccessible; yet the consequences are of importance in preparation for the study of uplifted coral islands. In the absence of detailed information regarding the structure of such islands—information that may be difficult to secure because of the alteration of their limestones by re-solution and crystallization, as well as by reason of insufficient dissection by valleys and of excessive obscuration by stalactitic deposits and by vegetation as Andrews found to be the case in the Fiji Islands[4]—there is no independent confirmatory evidence to show that this theory provides the counterparts of the facts.

There is one element of the theory which appears to be contradicted by the facts; namely, the origin of the lagoons of atolls by

[3] Die Sunda Expedition, Vol. 2, 1912, pp. 132-174.

[4] E. C. Andrews: Notes on . . . the Fiji Islands, *Bull. Mus. Comp. Zool. Harvard Coll.*, Vol. 38, 1900, p. 12.

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solution of the earlier formed, inner rings of reefs. The inner edges of certain atoll-reefs appear to be suffering solution; but the lagoon bottoms do not show either the ragged forms that solution should produce, or deposits of insoluble residues that should remain after solution; the best studied lagoons appear to be receiving new organic deposits. Observations made at Funafuti are especially significant on this point: a great part of the lagoon bottom there is "covered with a dense growth of a green calcareous alga," which "forms a living carpet"; "this mass of vegetable matting has a remarkable resemblance to a peat bog. The upper surface is green and living, but below the mass is dead and decaying."[5]

The important share that bacteria may take in causing the precipitation of calcic carbonate from solution in sea water and the large volume of oölitic limestone that is formed from the resulting calcareous mud have been emphasized by recent observers, especially by Vaughan, whose recent studies, based on chemical analyses of the sea water in reef lagoons, disprove the origin of lagoons by solution.[6]

One of the most important postulates of this theory is that a deep, still-standing bank may be built up to small depth by non-coral organic deposits, either living there or falling in an "organic rain" from near the sea surface; and this is of particular interest, as having been shown to be possible some forty years after Darwin announced his theory of subsidence. That submarine banks actually are built up in this way is thought to be proved by certain dredgings, as in the Seine and the Dacia Bank in the Atlantic off the coast of Morocco, and elsewhere;[7] but the proof does not seem to hold: the mere occurrence of non-coral, organic deposits on such a bank does not demonstrate it to be still-standing; it may be subsiding faster than it is built up. Independent evidence, showing that this possible explanation is a true and actual explanation, is wanting and must long remain wanting, because the facts that might provide such evidence are inaccessible. If borings should show that certain atolls have a thickness of only twenty fathoms of coral and lagoon limestone, formed in greater or less part of corals

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[5] The Atoll of Funafuti, Royal Society, London, 1904, pp. 177, 180.

[6] T. W. Vaughan: . . . On the Formation of the Floridian and Bahaman Oölites, *Journ. Wash. Acad. Sci*, Vol. 3, 1913, pp. 302-304; and, Sketch of the Geologic History of the Florida Coral Reef Tract, *ibid.*, Vol. 4, 1914, pp. 26-34; see p. 27.

[7] J. Y. Buchanan: On Oceanic Shoals Discovered by the SS. "Dacia," *Proc. Roy. Soc. Edinb.*, Vol. 13, 1885, pp. 423-443.

Sir J. Murray: Balfour Shoal, a Submarine Elevation in the Coral Sea, *Scott. Geogr. Mag.*, Vol. 13, 1897, pp. 129-134.

in place around the margin and of lagoon muds in the center, beneath which a volcanic foundation, or an organic cap on a volcanic foundation, were penetrated—or if similar structures were found in uplifted and dissected atolls—the theory would receive strong support; but until then, it affords only a permissible, not a compulsory explanation of atolls. If the horizontally bedded coraliferous "cover" of an atoll were found to be thicker than twenty or twenty-five fathoms, and if cross-bedded beach or dune sands, and layers of guano, were found beneath the surface, subsidence would be indicated. These are matters for future study. The present capital fact that independent evidence of subsidence is found in many neighboring barrier-reef islands makes the origin of atolls on still-standing foundations improbable, to say the least.

This theory therefore stands in an uncertain position—possibly true but not probably true, and not shown to be actually true in a single case. The leading facts which the theory seeks to explain are well generalized; the theory is ingeniously contrived so as to combine various reasonable processes; but its main postulate of a still-standing bank is improbable, in view of the abundant evidence of elevation or of depression, or of both, in oceanic islands where such evidence is visible; the consequences as to reef-structure cannot be tested because the corresponding facts are invisible. Judgment must therefore be suspended.

(*To be continued*)

GEOGRAPHICAL STATISTICS

By EUGENE VAN CLEEF
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Under the date July, 1913, the Handels-statistisches Amt of Hamburg issued a volume of 368 pages filled with detailed statistics covering the over-sea trade of the port. At first glance, an amount of figures such as are here included often appals the reader. However, close inspection reveals a very careful arrangement of intelligible tabulations. Inasmuch as the effect of the "glance" quite often precludes any further study, these volumes are usually relegated to the shelves for possible future reference merely. The writer sees very large possibilities in these statistics and is of the

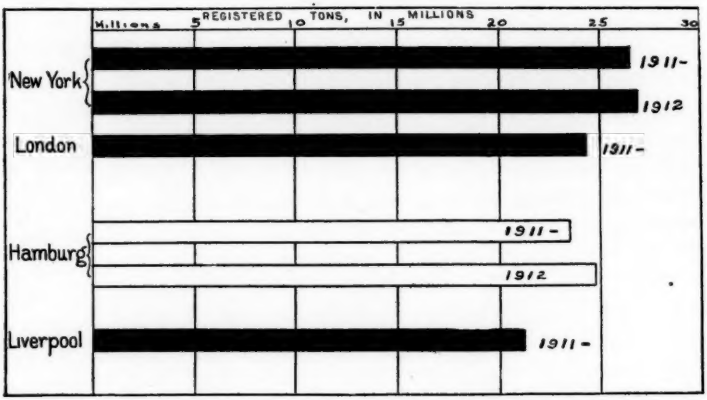

FIG. 1—The rank of Hamburg among the ports (in registered tons), exclusive of coastwise and river traffic.

belief that they should arouse a lively interest in and receive a cordial welcome from every geographer. With the desire to help stimulate greater activity in the more widespread use of statistics and, perhaps, to present a little material that will suggest some ideas worth while, a brief review of this report is attempted.

The volume is divided into four main parts as follows:

Introductory a—General review of the trade of the port for a series of years.

I. Navigation: a—Ocean Traffic; b—River Traffic.

II. Trade: a—Imports; b—Exports.

III. Review of Miscellaneous Facts: a—Emigration via Hamburg; b—Marine Insurance; c—Banking and Money Exchange.

The figures in the tables in Part I impress one with the immensity of the traffic in the harbor. At once the question arises as to Hamburg's rank among the world's harbors. Figure 1 indicates her as third in rank in *foreign* trade. These figures are exclusive of coast-

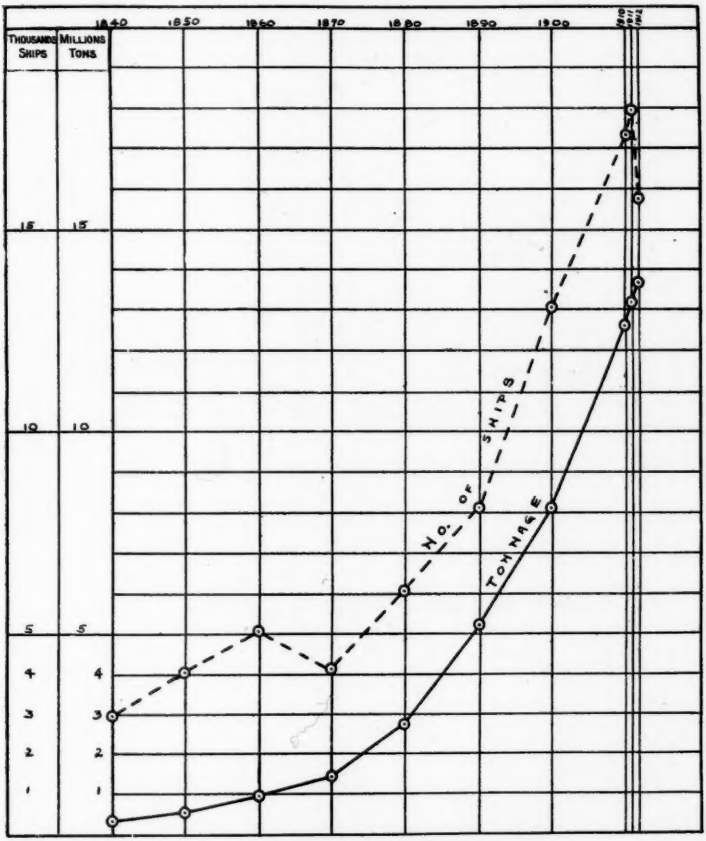

FIG. 2—Increase in ship tonnage of Hamburg.

wise and river traffic. Although the tonnage of the other ports shown in Figure 1 is not included in this volume the data are readily available.[1]

Our interest does not stop with a knowledge of her present

[1] Statistical Abstract of the United States; Statesman's Yearbook; reports of the respective chambers of commerce, etc.

importance but extends into the question of her rapidity of growth as a world port. Figure 2, based upon the report, indicates not only a rapid rise in tonnage but an increase at a quickening rate. Studies of fluctuations in the curve representing number of ships, of the relation of this curve to that representing tonnage, and other situations introduce a whole series of problems that cannot be here discussed.

In Part II appear the names of the countries with which the trade is conducted, the harbors involved and the nature of the

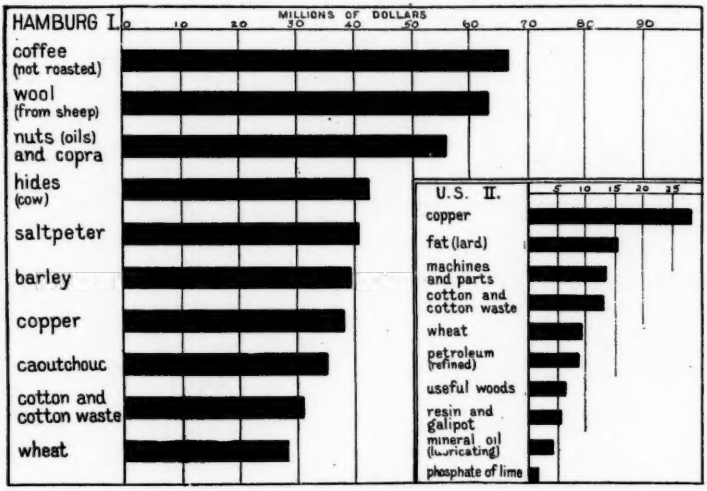

FIG. 3—(I) Ten leading products among 459 imported into Hamburg in 1912; (II) ten leading products among 408 imported from the United States in 1912. Both graphs show values in millions of dollars on same scale.

exports and imports. A few striking facts selected at random follow, to suggest the extensive opportunity afforded by these tables for studies in distribution. The tonnage in the trade with the Argentine in 1912 was practically equal to 40 per cent. of that with the United States; the difference in the amount of wheat imported from these two countries was only $158,330 in favor of the United States (see Fig. 3 for United States exports to Hamburg). In the trade with the United States, the port of New York ranks first, above Philadelphia, while Baltimore as third precedes Boston. The articles of import into Hamburg total 459 and those of export 441. The quantities and respective values for each are detailed. Then

follows a careful analysis of the total trade in these products to show with what countries business was done. Added to the itemized statement for 1912 is a summary for each year from 1909 to 1912 inclusive.

But this is not all. The articles themselves are alphabetically arranged and the countries involved in their exchange listed underneath each. The amounts and values for the trade in 1911 and 1912 respectively complete that tabulation. Figure 3 illustrates only one

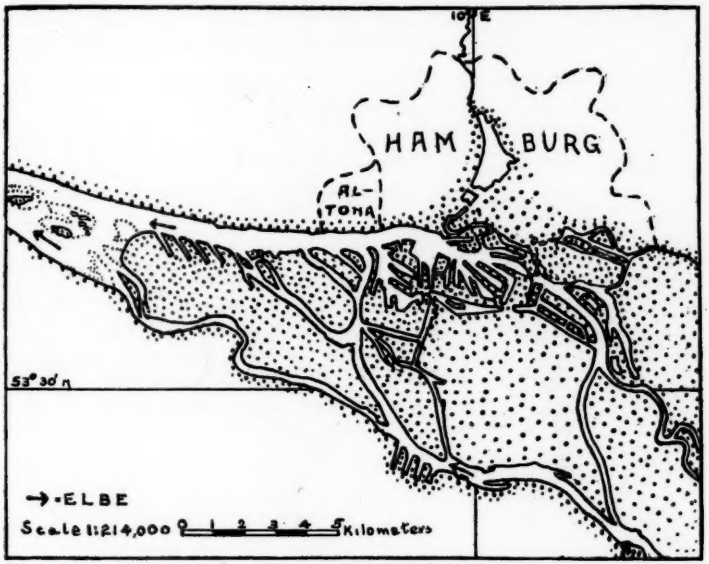

FIG. 4—Sketch map of Hamburg Harbor.
(Based on the Diercke Schul-Atlas and other sources.)

manipulation with these figures, of many that are possible. The ten products representing the largest total values in the imports from all countries have been ranked and, for comparative purposes, the ten products representing the largest total values in the imports from the United States have been ranked and drawn on the same scale. Three of the ten articles that lead in the Hamburg trade come from the United States in large part, namely copper, cotton and cotton waste, and wheat. While these rank seventh, ninth and tenth respectively in Hamburg's total imports, they rank first, fourth and fifth in the imports from the United States. Of the

$38,000,000 of copper imported by Hamburg, $28,000,000 (73 per cent.), or nearly three-quarters, came from the United States; of the $32,000,000 of cotton and cotton waste imported by Hamburg, over $13,000,000 (37.5 per cent.), or more than one-third, came from the United States; although Russia is not far from Hamburg, over $9,000,000 (33⅓ per cent.), or one-third of the $27,000,000 of wheat, was imported from the United States. There seems no end to the many interesting and significant relations that may be uncovered and the subsequent discussion that may be developed therefrom.

The analysis of the commerce as carried on in ships navigating under the flags of the various nations brings to light the almost

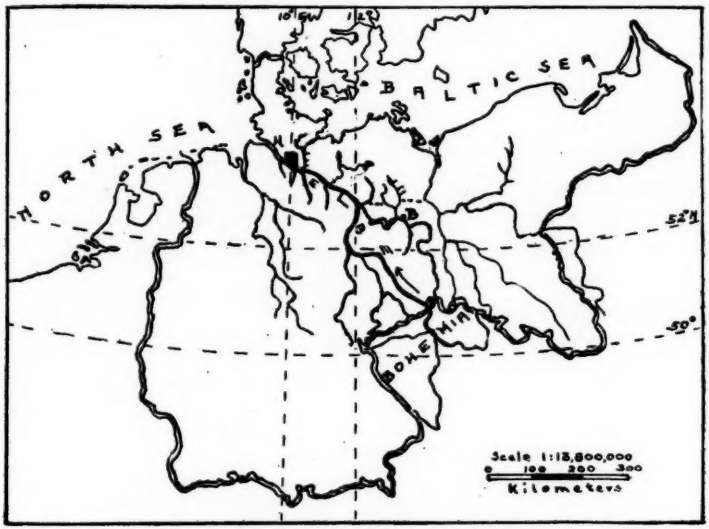

FIG. 5—Sketch map to show Hamburg and the Elbe system.
(Based on map in Hettner's *Grundzüge der Länderkunde.*)

pitiful sight of only an average of two ships per annum under the flags of North American countries, including the United States, during the twenty-year period from 1891 to 1910; and absolutely none since 1910. On the other hand, the almost overwhelming figures for the trade in ships flying the German flag presents a remarkable contrast that needs explanation. In 1912, 9,716 ships totaling a tonnage of 7,947,670 carried the imports to Hamburg. The British flag floated over 3,398 ships that entered Hamburg and totalled 4,037,900 tons.

The statistics indicate Hamburg's supremacy as a port over all other German ports. The reason is at once sought. Aside from any artificial factors that may be involved, it seems apparent from Figure 5 that its location is the primary factor. It is situated at the head of an estuary which initially possessed good conditions for an excellent harbor accommodating practically all small craft. Subsequently, with increase in traffic and size of boats, it lent itself readily to dredging and enlarging. Again it is at the focal center of the navigable Elbe, its tributaries and intersecting canals, that drain through the vast plain of northern and central Germany and concentrate the directions of the avenues of trade.

It is quite impossible to discuss at length in this paper the figures so clearly and admirably presented in the report under consideration. Perhaps some suggestions have been thrown out in this brief survey. In any event, such a valuable group of data ought to receive as much attention and interpretation as any other contribution to geographical information. In fact one must recognize that, after all, figures form the basis for most reliable discussions. If geography is ever to be included within the sphere of the "exact sciences," or even make a close approach, it must be founded, in part at least, upon definite works such as the delightful and welcome report of the Handels-statistische Amt of the Hamburg Chamber of Commerce.

XUM

THE INFANCY OF SPEECH

By WILLIAM CHURCHILL

Philology, after its first gropings to establish the method and its half century of establishing the fatherhood of the modern languages, has been halted at the irreducible primitive elements which it has discovered. The most recent activity has been expended upon classification and the correction of systems. The inquiry into the beginning of the speech of man was blocked by the speech of beginning man, the root, as the result of diligent analysis. Below the root nothing could be imagined. The lines of inquiry led to nothing more primitive, therefore inquiry was brought to a stop.

The root as the ultimate of philological study of the higher languages is a vowel or a combination of vowel and consonant. Illustrating by the use of A as the type of all vowels, M as the type of all consonants—and they are so early in evolution that they may stand for the parents of all of their class—the root possibilities are reducible to A, MA, AM and MAM. Of these A is common to man and vocal beasts, the last three are the sole and unique possession of man among the primates, admitting as an at present undetermined possibility that a slight possession of consonant ability may be found among the quadrumanes. At this point we long rested; although we recognized that a purely vowel root might exist with its charge of meaning it was accepted as beyond peradventure that the root in which the consonant is involved is insusceptible of further reduction.

Now comes a most important discovery out of Africa to assail this position. We have a brilliant analysis of the speech of the Pangwe,* a language poised on the threshold of agglutinating speech, that is to say one step above the isolating or most primitive type of speech. We cite in full a translation of Mr. Tessmann's carefully prepared statement.

"The stem of the present day monosyllables consists of consonant plus vowel. We have here three primordial consonants: palatal *k*,

*Die Pangwe. Völkerkundliche Monographie eines westafrikanischen Negerstammes. Ergebnisse der Lübecker Pangwe-Expedition 1907-1909 und früherer Forschungen 1904-1907. Von Günter Tessmann. Vol. 1: xxi and 275 pp. Vol. 2: 402 pp. Maps, ills., index. E. Wasmuth A.-G., Berlin, 1913. Mk. 30, 2 vols. 11½ x 8.

lingual *t*, labial *b*, and three primordial vowels which correspond in signification with the primordial consonants, namely *a*, *i* (*e*), and *o* (*u*). The signification at the point of origin lies as follows: with the combination *k-a* in the evaluation of the idea expressed by the word; with *t-i*(*e*) in its property; with *b-o*(*u*) in its relation. The primitive association between thought and sound may thus be stated:

"1. Evaluation: anything which arises outside of my will yet which may be brought by me into harmony with my view; anything which opposes me as something hostile, or which I oppose; destiny; the past.

"2. Property: anything which at the present moment is neutral to me, neither hostile nor friendly; the present.

"3. Relation: anything that I wish or that repays my effort, my direction or my choice; what is in a friendly attitude toward me or to which I am friendly; inclination; the future.

"Warning of danger, for example, is an evaluation, therefore the gutturals of the warning apes, to which corresponds in origin the exclamation *ka* of the Pangwe expressing astonishment or alarm. The wish to possess an object is a relation, and we find it among the anthropoid apes on the edge of the lips and among the Pangwe the same. When one points at an object in order to possess it the pointing of the finger does not signify relation but an evaluation in a hostile sense or a property, and in common intercourse is held unbecoming."

Mr. Tessmann develops his thesis with great accuracy and with abundance of material proof, but we need here go no further than the foregoing statement. It will be seen that he has established sense-classes in the primitive root and that he has implied a speech community with the anthropoids. As a conclusion from investigation based on a speech which has already reached the second stage this is as far as the student may venture. None the less it is a triumph in that it has passed beyond the barrier of the hitherto irreducible root.

Tessmann is entitled to the fullest credit for his discovery. It is the product of his own fresh research. He deserves to rank among the pioneers of the new philology, that enthusiastic band devoted to the establishment of human speech as an integral chapter of the evolution of man. He is its second member.

In this science I have established a priority of no more than eight years. I would not in the least detract from the credit of

the present discovery. My only advantage was that I began my studies upon speech yet more primitive, the isolating languages of Polynesia, and therefore made a start nearer the goal than the Pangwe agglutinants could afford. In a prolegomenon to this great topic I published a paper on "Root Reducibility in Polynesian" (*American Journal of Philology*, Vol. 27, p. 369). The sum of my conclusions was then that the vowel in speech, shared by us with the animal in its sense-expressive cry, carries the general sense of position in place and time relative to the speaker, to which manner is added by a growth in the controlled employment of intonation, and that the consonants which man alone possesses as modulants of the vowels have a coefficient value which particularizes the sense generalized in the vowel member of the root. I may say that continued research has confirmed and enriched the conclusions at which I then arrived.

A great value of this determination in the Pangwe lies in the fact that Tessmann was wholly unfamiliar with the earlier discovery and therefore reached his conclusion without prejudice. His was the distinct advantage that when he was conducting his investigation he was able to compare face to face the Pangwe with their fellow citizens of the trees, whereas in the Pacific study I was in the position of estimating the speech of anthropoids by inference. Tessmann has not ventured upon so broad a treatment as that in which I felt justified by the data upon which I worked, therefore his result is stated in more particular terms. But that result is the same. Primordial man has the use of vowels through his inheritance of the wholly vocalic animal cry; he is acquiring the closures of the mouth organs out of which he may develop a fine array of consonants to serve as modulants of the diffuse vowel significations.

Disregarding the question of priority, regarding the result of independent inquiry as the strongest measure of corroboration, it is a distinct pleasure to welcome Tessmann as an equal pioneer to the philology of the beginning man. For we need such arguments in order to convince formal and systematic philologists that the next great advance in the science is to be made through the tongue of the savage man who lives nearest the animal.

THE PERIOD OF SAFE PLANT GROWTH IN MARYLAND AND DELAWARE*

By OLIVER L. FASSIG

It is customary to establish the period of safe plant growth for a locality by determining the average dates of the last killing frost in spring and the first killing frost in fall, for the locality in question; the length of the intervening period may be regarded as the mean frostless period. When a temperature of 32° or below occurs without the occurrence of frost during a critical period after plant activity has begun in the spring, or in the early fall before the crops have all been gathered, the date of occurrence of the last and first temperature of 32°, respectively, is substituted in place of a killing frost in determining the average dates of the last and first frosts. The occurrence of frost does not generally coincide with the occurrence of a temperature of 32°, owing to the custom of exposing the thermometer in a shelter several feet above the ground. The difference between the temperature upon the ground and the temperature within the shelter, about five feet above the ground, may be as much as 10°, the degree of variation depending upon the topography and the weather conditions. As a rule the temperature at the ground is distinctly lower during the night hours than the temperature in the shelter; this condition may be reversed, however. Since the frostless periods based on the last and first occurrence of frost and on the last and first occurrence of a temperature of 32° are not of equal length, the usual method of calculating this period from records made up of both kinds of observations is obviously open to criticism. The use of an occasional freezing temperature to complete a long record of observed frosts is not objectionable, but a frequent substitution should not be resorted to.

In order to learn the extent of the difference in the length of the frostless period, or rather the difference in the length of the period of safe plant growth as determined by means of the two methods described, two distinct series of observations were tabulated and compared for all stations in Maryland and Delaware having a record covering a period of ten years or more. Fortunately, we have in these states a large number of carefully made observations extending over periods varying from ten years to forty-three years. The average length of these records is twenty years, confined mostly to the period from 1890 to 1913. The accompanying table [shown by Mr. Fassig] exhibits the following facts of importance in making a comparison of the two methods of determining the frostless period:

1. The location of all stations having a record of ten or more years.
2. The length of each record.
3. The average date of the last and first killing frost.
4. The average date of the last and first temperature of 32°.
5. The average length of the intervening periods.
6. The average difference in the length of the two periods.

* Abstract of a paper read at the joint meeting of the American Geographical Society and the Association of American Geographers in New York City, on April 3, 1914. Illustrated by charts.

The tabulated results have also been charted, bringing out more clearly the geographical differences in the length of the periods as determined by the two methods of calculation.

The accompanying table and charts† are interesting and instructive and suggest the advisability of adopting a uniform method of determining the period of safe plant growth, and they also appear to demonstrate the superiority of the method based upon the last and first occurrence of a fixed temperature, for example 32°, over the usual method of observing and recording the dates of the last and first killing frosts in spring and fall, respectively.

Some of the reasons which may be advanced in favor of the method of determining the period from the temperature records are the following:

1. The temperature is observed and recorded regularly, and the record is therefore complete for the entire season.
2. Frost records are apt to be incomplete unless they occur at critical periods in plant growth. This failure to record frosts is particularly noticeable in records of spring frosts; stations having excellent fall records have often a very defective record of spring frosts. Frosts occurring after a long period of warm weather, as in summer or early fall, are likely to be more conspicuous events than the last of a series of many frosts occurring throughout the winter and early spring.
3. In recording frosts there is always a variable personal factor, opinions differing as to the extent and severity of the frost, resulting in the same frost being designated as heavy or killing. In recording temperatures, on the other hand, this personal factor is practically eliminated.
4. There is a fairly fixed and uniform relation existing between the temperature in the shelter and the occurrence of a killing frost in any given locality, and this factor can be readily determined from a comparatively short series of observations.
5. For reasons stated above a reliable "frostless period" may be established for a given locality from a shorter series of observations by the use of a temperature record than by the use of a frost record.

The Maryland and Delaware records, covering an average period of twenty years at fifty stations, show that the frostless period based on the observations of a temperature of 32° is about ten days longer than the period based on the occurrence of killing frosts. This relation holds good for stations in open level places, but apparently does not hold for stations in the mountain districts, where the period based on the occurrence of frosts is about ten days longer than that determined from a record of freezing temperatures in a shelter five feet above the ground.

The necessity of charting these two systems of observations separately is apparent, and I am convinced that the method of temperature observations is the better method. The formation of frost depends not only upon the occurrence of a temperature of 32° or lower, but also upon the relative humidity of the air at the time and place of formation; the temperature may fall considerably below the freezing point for water without the occurrence of frost, in a dry atmosphere. The injury to plants is probably as great in one case as in the other, yet the absence of frost may give the impression that no injury has resulted.

A comparison of the charted results of the two methods shows a similar configuration of the lines of equal frostless periods and of lines showing the

† Only one of the charts is shown here.

beginning and ending of the periods, but the charts based upon the temperature records show greater detail owing to the use of the greater number of stations and the greater average length of the periods of observation permitted by the temperature method.

Nearly all of the temperature observations used in the construction of the accompanying chart were made under similar methods of exposure of thermometers—namely, in standard Weather Bureau shelters, about five feet above the ground, in country districts, or in open places in small towns. Proper allowance must be made for temperatures observed under conditions which differ widely from the usual methods of exposure, such as those made in large cities, like Baltimore and Washington, where the thermometers are exposed upon the roofs of buildings at elevations of 100 feet or more above the ground.

The charts show quantitively what has long been recognized in a general way, namely, the great influence of Chesapeake Bay in lengthening the period of safe plant growth in Maryland. This fact is conspicuous in all the charts.

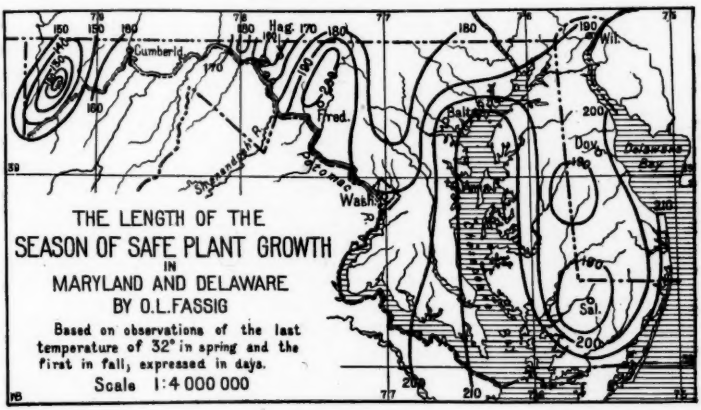

FIG. 1.

The protecting influence of the mountains in the western part of Maryland is also clearly shown in the greater length of the frostless period on the eastern, or leeward side, and in the contrast between conditions on the western and eastern sides of the Blue Ridge Mountains in Washington and Frederick Counties.

The length of the period of safe plant growth along Chesapeake Bay in southern Maryland is longer by nearly 100 days than the period in Garrett County in the mountains of western Maryland.

Taking the average for a long series of years a temperature of 32° or below disappears for the season along the shores of Chesapeake Bay and along the Atlantic coast about April 5; and again makes its appearance in the fall about November 10 or 12, showing a period of safe plant growth of about 210 days. These figures apply, however, only to localities near the shore, the length of the period diminishing rather rapidly with the distance from the water's edge. This protecting influence of the bay is strikingly brought out

in the chart, showing the variations in the length of the frostless period on what is known as the "Peninsula"—the district in Maryland between the Atlantic Ocean and Chesapeake Bay. In the central portions of the Peninsula, farthest away from the bay and the ocean, regions in which nocturnal radiation is more active than in the immediate vicinity of large bodies of water, freezing temperatures do not usually disappear in the spring until April 15 to 20, and reappear in the fall about October 20 to 25, decreasing the period of safe plant growth from 210 days near the shores to 190 days at distances only twenty to twenty-five miles inland, a difference of twenty days.

In the mountain districts of the Blue Ridge we have a striking example of the protecting influence of a mountain range stretching across the path of the prevailing westerly winds. On the western, or windward side of the Blue Ridge, in the lower levels of the Cumberland Valley, the frost period extends into the first week of May and reappears in the fall in the first decade of October, showing a period of safe plant growth of about 160 days; on the eastern, or protected side, of the Ridge the period is lengthened to 190 days, and even 200 days, the freezing temperatures disappearing about April 15 and reappearing in the third decade of October. In the mountain districts the variations in the length of the season are to some extent due to cold air drainage during clear and calm nights, and cannot be altogether attributed to the protecting influence of the mountains against the cold westerly winds.

In the most western county of Maryland we find another factor entering into the length of the period of safe plant growth, namely, that of elevation. The general level of Garrett County is not far from 2,500 feet above sea-level, with peaks rising to 3,000 feet. Here we have a very decided shortening of the period, injurious frosts extending into the early days of June, and appearing again about the middle of September, showing a period of safe plant growth of but little more than 100 days in the areas exposed to intense nocturnal radiation and to extensive air drainage.

The dates and figures quoted, it should be kept in mind, are average values, based upon a long series of years of carefully made observations. The variations from these average or normal values from year to year are of course large, and the extent of variability from the normal dates of occurrence of the last killing frost or frost temperature in spring and the first in fall is a very important factor of the climate of any given locality. A further study of this matter will be made later; the primary purpose of this paper is the determination of the best method of calculating the period of safe plant growth, and the normal length of the period in the states of Maryland and Delaware.

GEOGRAPHICAL INFLUENCES IN AMERICAN POLITICAL HISTORY*

By FREDERICK JACKSON TURNER
Professor of History, Harvard University.

The frontier[1] and the section[2] are two of the most fundamental factors in American history. The frontier is a moving section, or rather a form of society, determined by the reactions between the wilderness and the edge of expanding settlement; the section is the outcome of the deeper-seated geographical conditions interacting with the stock which settled the region. Sections are more important than states in shaping the underlying forces of American history.

The economic, political, and social life of the United States, even its literature, psychology, and its religious organizations must be described by sections; there is a geography of public opinion. In spite of similarity of traits and institutions throughout the nation, it is also a congeries of sections. Political leaders usually gain a national position by first convincing their own section, expressing, as well as leading, its ideals and wishes, and then combining it with other sections under political adjustments.

Political sectionalism exhibits itself most obviously:

1. In a group of states contending with other groups, or with the nation, as in the case of North against South, West against East, or the Northeastern group of Federal states against the rest of the nation. Such a grouping by states, however, conceals interior divisions and needs further analysis.

2. A sectionalism by congressional districts, not confined within state lines, is exhibited by mapping votes in Congress, attributing to the district the views of its representative in the House. Such maps of votes show that party voting is often subordinated to sectional voting; the sections reflect the influence of physical geography as well as of other factors. This method of exhibiting geographical influence is limited by the frequency of the cases where the congressman does not fairly represent the mass of his constituents, as well as by the size of the congressional districts, and by the practice of "gerrymandering" the districts in order to gain a party advantage.

3. By mapping presidential and state elections, using towns or counties as the unit, a closer approximation to the geography of political areas is possible. Such maps show more clearly the geographical influence and in greater detail. They disclose the fact that there are both interstate and intrastate party areas persisting in some cases for many decades or even generations and having clear relations to natural geographic factors. But the county itself is too

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* Abstract of an address before the joint meeting of the American Geographical Society and the Association of American Geographers in New York on April 4, 1914.

[1] F. J. Turner: Significance of the Frontier in American History, *Report American Historical Association*, 1893, p. 199.

[2] *id.:* Is Sectionalism in America Dying Away? *American Journal of Sociology*, Vol. XIII, p 661. See also the author's articles on "Frontier" and "Sectionalism" in Hart and McLaughlin (editors): Cyclopedia of American Government (in press).

large an area to tell the whole story. It often lies athwart diverse geographical areas, and has diverse economic and social groups within it.

4. The final refinement of such mapping would be by election precincts which would be a much more satisfactory mode of exhibiting the relations of voting to soils, resources, position, population, etc. But at present this has been insufficiently carried out.

Limitations of the method must be noted. The existence of a minority is concealed, though the vote may be close. Great political changes may occur where a mere plurality is the test without materially altering the appearance of maps of county units, inasmuch as the size of the plurality is not recorded; the city in one corner of a state may outweigh all the varied sections of the rest of the state; even the bulk of a party vote may theoretically lie in the areas not depicted as the areas of this party. Moreover, parties are held together by combining various issues in order to hold dissenting elements, and by stating issues ambiguously; platform and candidate are also sometimes inconsistent. Thus the issue for which a geographical interpretation is sought may be confused, if the question is one of political opinion rather than of party habit.

The method, therefore, has its special value in revealing the party inertia of geographical areas rather than in its use for the natural history of political parties, as organizations, though it is also useful in this respect. By mapping votes by percentages, as in the presidential election of 1880, mapped in *Scribner's Statistical Atlas*, many of these objections may be met. Such a system, however, confirms the general correctness of the coarser reconnaissance system of mapping by pluralities used in illustration of the present paper. Areas of transition and of political instability are brought out more clearly by percentage mapping but the more durable and pronounced political areas remain substantially the same under both systems. In other respects also the limitations noted in theory are not so important in practice as they might seem.

Conceding the limitations of the method, it nevertheless reveals a most significant geographical influence in American political history which needs further study.[3] The series of maps illustrating the various modes of mapping described above show that geographical influence exists both in regard to the groups by states, and in groups by lesser units. Refinement of the mapping discloses increasingly the importance of the geographical factor. Groups of states like the New England-New York Federalist group tend to reappear whenever issues reappear affecting the interests of capital, as in the election of 1828, the Bland Allison Act of 1878, and the Gold Democrats of the Chicago

[3] The studies of political geography which were begun in the author's seminary in American history with a paper by Orin G. Libby, now professor in the University of North Dakota, in 1894, on "The Distribution of the Vote on the Ratification of the Federal Constitution," have been continued since by my students and myself. More recently the Carnegie Institution has undertaken the publication of an atlas of American history in which the method of mapping votes will be used. The writer has not had the advantage of consulting this work as yet, and the present study is in the nature of a reconnaissance paper. For studies of state sectionalism see lists in Turner: Essays in American History, p. 207; A. W. Small: General Sociology, pp. 282–3, note; C. A. Beard: Economic Interpretation of the Constitution, p. 5. See also W. E. Dodd: Fight for the Northwest, *Am. Historical Review*, Vol. XVI, p. 788, map; Boyd: Antecedents of the North Carolina Convention of 1835, *South Atlantic Quarterly*, January and April, 1910; J. A. Morgan: State Aid to Transportation in North Carolina, *N. C. Booklet*, Jan., 1911; F. H. Giddings: Conduct of Political Majorities, *Political Science Quarterly*, Vol. I, p. 116.

Convention of 1896. The areas mapped by congressional districts also show marked persistence and relationship to lines of communication and centers of capital.

In the mapping of presidential elections by county pluralities from 1836 to the present, the most obvious distribution is into northern and southern political zones, with ragged, intermingling edges. But this fails to reveal fundamental differences between the eastern and the western wings of the various parties, held together by an unstable party alliance. Composite maps exhibiting state elections about 1800 and 1830 indicate the importance of this difference between eastern and western areas at different early periods. It is also clearly shown in recent political history.

The northern area, which tended to be first Federalist, then Whig and then Republican, is broken by groups of opposition counties chiefly in interior regions. The strength of the Whig-Republican area is along such lines of communication and industry as the Great Lakes, the Potomac, and the upper Ohio. It is strongest generally along the routes of capital, commerce, industrial energy, and density of population, with frequent exception of the great cities, where class voting modifies the rule. Even in the city, however, bipartisan organizations tend to make party lines conceal a real identity with the geographic distribution above noted.

This Whig-Republican northern zone was deeply influenced by the distribution of the descendants of New England stock (including the later generations of central and western New York), who occupied the shores of the Great Lakes —particularly in western New York, the "triangle" in northwestern Pennsylvania, the Western Reserve in Ohio, and in parts of Michigan—and the prairie regions of southern Wisconsin, northern Illinois, and part of Iowa, Kansas and Nebraska. Here the persistence of feelings aroused by the issues of the Civil War is also noteworthy.

The Democratic areas in the northern zone give distinct evidence of the location of the southern upland settlers who came to the forested area, before the New York-New England settlers. Here factors of social origin coincided with geographical influences proper. These persistent political groups appear in a series of maps of elections in Ohio, Indiana, and Illinois between 1828 and 1908. For example, the counties bounded by the lines of the Western Reserve on Lake Erie normally vote in the same way, year after year. In Indiana the political grouping is in persistent vertical tiers of counties. In Illinois a map of party grouping looks like a map of the original forest and prairie areas, with the glacial lobe extending from Lake Michigan clearly visible.[4] In eastern Wisconsin and in the Illinois counties adjacent to St. Louis, the German area emerges, in the former as a group of Democratic counties in a Republican region, whenever special issues call it forth; and in the latter regularly as a group of Whig or Republican counties in a Democratic area.

In the lower South from 1836 to about 1850 when the slavery issue blurred the old divisions, the Whig and Democratic areas are strikingly reflective of geological formations. By combining the results of the presidential elections of 1836 to 1848 inclusive to show how pluralities were distributed in three or

[4] Compare E. B. Greene: Sectional Forces in the History of Illinois, *Transactions of Illinois Historical Society*, 1903, p. 75; H. H. Barrows: Middle Illinois Valley; A. Shaw: Local Government in Illinois; J. P. Goode: Geography of Illinois.

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all of these four elections it appears that the Whig area was practically identical with the chief cotton raising counties, and that the most important Whig counties were in the belt where the negro was nearly or quite the majority of the population. Of the counties within the Black Belt (*i. e.*, where the negroes were an actual majority of the population) the Democrats carried but two in Georgia, three in Alabama, and four in Mississippi in three-fourths of these elections. Outside of the chief cotton counties the Whigs carried few counties in the same states. The Democratic counties in the same states for this period were almost entirely in the regions of inferior soils.

More particularly the Whig counties occupied the best cotton soils of eastern and central Georgia, (the majorities becoming weaker or vanishing in the Pine Hills strip running through the Cotton Belt). They were located in that part of Alabama known as the Inner Lowlands, bounded on the south by the cuesta (especially by the Chunnemugga Ridge), and on the north by the Pine Hills and the Tuscaloosa strata. The Whig belt, resting on this intermediate strip of calcareous black prairie, swings northwestwardly into the closely divided Whig and Democratic counties at the eastern edge of Mississippi. The alluvial belts along some of the rivers and the limestone area of the Tennessee in northern Alabama supplement this central cotton belt, but in northern Alabama the Democratic influence is the stronger. In Mississippi the Whig counties are largely confined to the alluvial zone adjacent to the Mississippi River and adjacent counties. Tennessee's three natural geographical areas find marked reflections in the political map of these four elections, the Whig areas being the cotton counties of the west, adjacent to the Mississippi, the limestone island of middle Tennessee, and the counties in the fertile valleys of eastern Tennessee. The Democratic counties, with rare exceptions, were the less fertile, rocky soils bounding these Whig areas. The geographical influence becomes clearer the farther this analysis is refined in each of these main areas.

These divisions of the Lower South,[5] obliterated in large measure in the era of civil war and reconstruction and in the later solid South under the influence of the negro problem, still tend to reveal their outlines when tested by mapping minorities and by primary elections in which the negro issue is eliminated. This distribution has also its social aspect, inasmuch as when the area was settled, in the bidding for the best cotton lands the wealthier slave holder excluded the non-slaveholding white, whom economic considerations, and in part his tendencies as a pioneer farmer, turned to the up country and the sand barrens. The Whig aristocracy naturally supported the banking policy of its party, inasmuch as property and the credit needed in their cotton planting were basal in their economy. In Kentucky conditions existed comparable to those in Tennessee, and a similar analysis is possible for other parts of the South.

In the Southern Appalachian area similar composite maps for both the Whig and the Republican period from 1836 to 1908 show that the Whig area was strongest on the lines of communication, and in the bottom lands, while the Democrats were strongest in the upper country. The Republican area shows continuous extension along the Southern Appalachians, becoming a wedge thrust down into the south from Pennsylvania. It is made up only in part of former Whig areas, for it tends to include normally the "white"

[5] See also U. B. Phillips: Southern Whigs, in Turner: Essays in American History, pp. 209, 214-215.

counties above the thousand foot contour as well as the lines of communication.

Many minor geographical aspects might be noted, such as the tendency of the area of the Dismal Swamp canal to go with the northern parties; the persistent trough of Federalists and Whigs running to the interior of North Carolina diagonally from the coast; the efforts of the Tennessee River to assert its presence again and again by showing Whig and, later, Republican counties along its whole course.

In recent political struggles between West and East, the relations of Grangers to the prairie, wheat raising areas, and of the Populists to the later wheat and silver producing areas, are significant. The factors of declining prices of crops, mortgaged farms, appreciating gold and declining silver values as the silver mines were exploited, coincide with transportation problems to produce significant reactions between geography and political history; and these factors are significantly emphasized both by the study of the section made up of groups of states and by the closer analysis of counties.[6]

Perhaps the most fundamental generalization is that there are areas influenced or controlled by geological factors wherein capitalistic considerations are strongest, and that such areas tend to be Whig and later Republican. These capitalistic basins and the conduits of communication between them show increasing tendency to gain at the expense of the intermediate regions less favored by geographical advantages.

Such a generalization is subject to exceptions; there is not absolute geographical control; social or psychological considerations sometimes reverse the result. But there is in each state a normal antagonism between certain sections, on whichever side they take their party stand. As a further consideration it is important to repeat that interstate migration has tended to distribute such groups of settlers as those of New England ancestry and those of southern upland ancestry in special geological provinces. Party inertia is as fundamental as any one factor in determining the result.

The problem resembles that of a complex geological area and demands the use of the multiple hypothesis. Where there are so many possible factors for use in interpretation it is possible to select with unconscious prejudice and so reach unscientific conclusions.

But, whatever the difficulties of interpretation, the main thesis that there is a geography of American politics and that the relation between geography and political history becomes clearer the farther the method of investigation is refined, seems established. The facts demand combined investigation by geographer and historian.

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[6] See for example O. G. Libby: Study of the Greenback Movement, *Wisconsin Academy Transactions*, Vol. XII, p. 530; C. O. Ruggles: Economic Basis of the Greenback Movement, *Proceedings of the Mississippi Valley Historical Association*, 1912-1913, p. 143; S. J. Buck: Granger Movement (maps); E. E. Robinson: Recent Manifestations of Sectionalism, *American Journal of Sociology*, Vol. XIX, p. 446.

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THE EFFECT OF LEVEES ON THE HEIGHT OF THE RIVER BED

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The great flood of 1912 on the Mississippi, which inundated nearly 9,000 square miles of the protected basin, raised again the persistent question as to the effects of levees on the elevation of the river bed. The problem is to a great degree so intangible and so many different situations enter into it that a belief in the general elevation of the river bed due to levees is not strange especially in view of the constant necessity of increasing the heights of levees. The Mississippi River Commission were so embarrassed by the widespread use of the arguments against levees based on this false premise during the recent flood that they reopened the discussion in a report[1] and, from the work of the previous Commissions, reiterated the conclusions that there has been no measurable progressive elevation of the bed of the river during the period covered by the investigations.

The persistent belief is based generally on a number of common though incomplete observations:

1. The building up of a flood plain by successive overflows reducing the slope downwards from the natural levees to the back country gives excellent *prima facie* evidence of an upbuilding bed.

This has been used, especially in the case of the Mississippi River, as an argument against levees. It must be made clear at the outset that there is no denial of the fact that a river may build up its bed, and that a river with such a tendency may continue to upbuild its bed after levees have been constructed along its banks. Where leveed rivers aggrade their channels, the levees are not the cause of the action; rather the upbuilding has gone on in spite of the levees. In case of streams where the tendency to aggradation is lacking, levees not only do not permit continued deposition on the river bed but, on the contrary, seem to have a marked effect in improving a river's channel.

A number of investigations by the Mississippi River Commission sustain this point. The Mississippi River was surveyed during the years 1881-1883 and an average of four cross-sections per mile were taken along the river. The resurvey of the river between the years 1894-1896, especially in the section most improved by levees, yielded cross-sections of greater uniformity and capacity than those of the former surveys, and the conclusion was inevitable that the river channel had been improved by the confinement of the waters. A marked characteristic in the change was the consistent lowering of the crests of all bars in the crossings of the river. In 1880, the Mississippi near the mouth of the Atchafalaya River possessed cross-sections of unusual variety. The depth of the river showed no relationship to the spreading of the waters and, in many places where the river was wide, a deeper section was obtained

[1] Report of the Mississippi River Commission for the year ending June 30, 1912. pp. 3715-3717.

than in the contracted portions. In 1904, after levees had been constructed, the river showed unmistakable signs of cutting more regular cross-sections and the general flow of the low water stage was improved. These cross-sections were taken during low water, inasmuch as it was the belief that any silting up of the channel would be registered more convincingly by the gage readings of the low water stages than of the flood stages. Similar records come to us from the Po. During the first quarter of the nineteenth century the mean of the low water readings was 10.4 feet, during the second quarter 10.3 feet, and during the third quarter 10.1 feet. There was then, during seventy-five years, a slight though persistent lowering of the low water level although, as will be shown later, the flood heights had risen steadily. Such records are not compatible with a filling channel. In like manner, a consistent falling of the low water stages of the Rhine has been recorded at Cologne and Emmerich.

The striking feature of the flood of 1897 on the Mississippi River[2] was the greater height of the flood wave in the lower portions of the river than the stage at the upper river stations led the engineers and the riparian proprietors to expect. The proposition was established, furthermore, that this feature was not abnormal, but, on the contrary, such a change in the regimen of the river had taken place that any flood wave passing Red River Landing (765 miles below Cairo) at a high stage may be expected to cause a flood wave at Carrollton (950 miles below Cairo) a foot or more higher than a flood of the same height would have caused fifteen or twenty years ago. The explanation of this change in flood height has been that it resulted from the upbuilding of the river's bed, and, in this particular case, that the bed was filling about and below Carrollton. If such were the case, it is obvious that the effect, in the instance of low flood waves, would be proportionally more noticeable than in the case of the high. Tables of low flood waves show no tendency whatever towards an increase in the height of the low flood wave at Carrollton and the theory of a filling channel must be abandoned in this instance.

The experiment was conducted somewhat as follows: The low floods, which have been recorded since 1872 at Red River Landing and Carrollton, were tabulated. The gage readings, at Red River Landing, fall into three groups, 22.3 feet, 21.4 feet and 19.3 feet approximately. The ratio of the Carrollton stage to the Red River Landing stages, about 19.3 feet, are found to be uniformly less than those of the other two stages and, furthermore, the ratios have increased somewhat during later years. Another reason than the upbuilding of the river bed must be found to account for this situation. It can be shown that the carrying capacity of the river between Red River Landing and Carrollton has been increased. The effect of this would be shown especially during excessive stages of the river, and the greater distribution of the waters directly below the former station would tend to diminish the high water slope while little or no change would be recorded at the latter station because of this change. It was not so much that the flood height had been increased at Carrollton as that it had been lowered at Red River Landing.

2. On portions of the river's course, such as alluvial fans and deltas where the velocity of the river changes suddenly, the situation, while not different from the preceding, offers a greater opportunity for a superficial judgment against the levees. Here again it is not denied that the bed of the river

[2] Report of the Mississippi River Commission for the year ending June 30, 1900. p. 4551.

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aggrades, although, in the same breath, the assertion is made that levees not only cause no deposition of sediment but diminish the rate of deposition.

Instances have been cited from many rivers. Some rivers of Japan are reported[3] to have raised their beds. These occur, however, on the alluvial fans where the torrential rains bring great quantities of detritus from the mountain slopes to be deposited on the plains. The quantity of sediment may be so great and the plains so narrow that the entire lowland reach of the river is included in the fan limits. In some instances, where protecting embankments have been built, the river is forty feet above the plain, and the railroads across the lowlands have been placed in tunnels on a level with the surrounding country, underneath the streams, to avoid the inconvenience of floods and the constant demands of shifting the road-bed to the caprices of the upbuilding fan.

It would not be strange if the same condition obtained in the Hoang Ho, for the river brings a great volume of silt from the mountains and plateaus and an upbuilding process on the great river plain is easy to forecast. Many accounts of this river assert that where it is leveed the bed has risen above the surrounding country, but all these statements seem to eminate from a casual observer whose information was not altogether founded on careful investigation. The Mississippi River Commission published[4] in 1890 a letter from China, written by a person of competent authority, in which enough data are included to lead one to believe that no such silting as to raise any part of the bed above the adjacent country has ever taken place.

With the preservation of many ancient gages on the Nile, records covering a thousand years or more show a persistent upbuilding of the Nile Valley from Assuan down to the Mediterranean. The Roda Island gage, near Cairo, records a stage of river necessary for irrigation four feet above what was needed in A. D. 861, which indicates a general rise at the rate of 0.39 foot per century, while similar records below the last cataract give a rise of 0.43 foot per century.[5] This is apt to be the case in all delta building streams. The deposit of sediment at the mouth and the extension of the river's length diminish the slope of the bed; this in turn decreases the velocity of flow and causes deposition of some of the load of the stream until the slope is again restored. The prevention of the spread of the waters and the loss of velocity by the building of jetties has demonstrated the effectiveness of levees to resist this tendency if not to overcome it. Even in the Nile, the change has been so slow as to be practically imperceptible.

It is probable that the great extension of alluvial fan and delta in the case of the Po River has given rise to many conflicting reports from the Italian stream. The tributary streams which flow from the Alps upon the plains north of the Po demand for the transportation of the sediment a steeper slope than the lowland has and deposition takes place. This upbuilding will go on until a more or less permanent slope is attained. The Adige, so often used as an example of a stream whose levees are higher than the surrounding country, is a type of this kind. The bed of this stream would rise if left in its natural state and it can hardly be expected not to do so after the levees have been constructed.

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[3] Harcourt, L. F. Vernon: Rivers and Canals. Vol. I, p. 167.

[4] Report of the Mississippi River Commission for the year ending June 30, 1890. pp. 3093-3098.

[5] Thomas, B. F., and Watt, D. A.: Improvement of Rivers. p. 7.

The confinement of the sediment between the banks of the streams, which is discussed later, causes a more rapid outbuilding of the delta. This increase which is noticeable in the case of the Po will, because of increasing the length of a stream, diminish the slope and cause a deposit between the embankments. Thus, measurements of low water stages near the mouth of the Po will in all likelihood show a slight increase in the average reading in succeeding years. The increase in length of the Mississippi River is about four miles per century. The Mississippi River Commission figures that, with the existing slope, this increase of length would raise the high-water level at New Orleans about seven-tenths of a foot per century or at the average rate of eight-hundredths of an inch per year.

3. The necessity of raising the height of the levees to withstand the floods is used as an argument in favor of the upbuilding bed hypothesis. As the confinement of the waters becomes more and more successful, higher and higher levees are demanded. On the Po, where there has been a decrease of the mean low water during seventy-five years following the introduction of levees, the flood heights have risen steadily.

As the percentage of completed levees increases and the waters, instead of spreading over the broad flood plain are more and more constricted between artificial walls, the high water level will be raised. On the Mississippi River, at the present time, the levees are 81.6 per cent. completed and the uncompleted portions release large volumes of water which detract from the height of the flood crest. Thus, the high water of 1912, which exceeded all previous floods in height at all stations except Vicksburg, had its flood crest lowered by the escape of water through crevasses and over the uncompleted levees. At Greenville, Miss., on April 12, this flood had a stage of 50.75 feet with a previous highest at 49.1 feet during 1903. The Commission estimates that had the water been confined, the 1912 flood at this station would have been 52.8 feet.[6] The provisional grade determined for Greenville after the 1903 flood, to which the Commission has not been able to raise the levees, was 53.1 feet or 2.35 feet above the 1912 flood. The provisional grade is based on the estimated confined height of a flood wave and this estimate places the flood within .3 of a foot of the provisional grade. A new provisional grade based on the 1912 flood, which will be higher than the former one, will set a new height for levees at Greenville. It is absurd to argue that this increasing height of levees arises from deposition along the bed.

The confinement of the waters between levees and the consequent high stages of the river during floods give a greater slope and therefore a greater velocity to the current. The expectation would follow that, instead of depositing sediment, the transporting power of the stream would be increased and scour of the bed would result. It must be remembered that while the water has been constrained, the sediment which formerly was spread over the flood plain is now confined between the levees and the water must carry a larger load, but an increase in the carrying capacity has been effected which permits the waters not only to carry this additional volume of sediment but also to pick up more. A noticeable effect of this appears in the increase in delta building rate. Lombardini has calculated that the annual increase in area of the Po delta, for the period from 1300 to 1600, was 127 acres, but

[6] Report of the Mississippi River Commission for the year ending June 30, 1912. p. 3721.

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between 1600 and 1830 the rate was 324 acres. The introduction of levees on deltaic portions of a flood plain, because of the concentration of the flow, results in considerable scour; however, when normality is reached, under the new conditions, the increasing length of the river, which is caused by delta building and which goes on at a more rapid rate because of the confinement of the silt between levees, will result in slight, almost negligible upbuilding of the bed, some part of it being directly traceable to levee construction.

There are other phases of river activity under the present uncompleted state of levee construction which cause temporary deposits on the river bed to the embarrassment of the low water navigation. Crevasses occur during seasons of exceptional high water. The primary evils of such weaknesses in the levees are not pertinent to the discussion but, of secondary importance, are the deposit of sediment over valuable land and the lessening of the stream flow thereby to such an extent that a deposit may also take place in the river bed. The menace of water by levee construction demands a sure knowledge that the levees will withstand the force of the river; but if it does not, while people may escape destruction by heeding the warnings, they cannot escape the loss which results from the heavy deposit of silt dropped by the stream when it spreads beyond the limit of its confines. At the same time, in the bed of the stream there occasionally results a silting due to the loss of carrying power. This condition is analogous to two troublesome factors existing in the Mississippi River, *viz.*, the widening of the stream and the separation of a stream by an island, conditions which do not, however, fall into different categories so far as their results are concerned. In a number of instances on the Mississippi, the river increases in width as it leaves a pool section from half a mile to two miles within a short distance. In other cases the stream is divided by islands. These are the places where dredging has been most necessary and where the experimental wing dikes were constructed in the hope of ameliorating the river channels.

A deposit also takes place on the river bed under a rapid fall in the stage of a river. This deposit is not permanent, but it is moved during the next rising stage of the river; in the meanwhile, however, it is a detriment to low water navigation. If the fall in stage is gradual, the river generally distributes its load and carves out a low water channel. The fall in stage due to crevasses will be prevented to a great degree by an efficient levee system, but the sudden fall in stage due to the distribution of rainfall can be overcome only by withholding enough water in storage to regulate the rate of fall in the stage of a river.

4. In a river free to develop meanders, the tendency to increase the radius of curvature increases the length of the stream and consequently diminishes the slope frequently to such an extent that the lessened velocity is not sufficient to transport the sediment. In such a case there would be an upbuilding of the upper part of the river bed to give a velocity capable of doing the work. This tendency rights itself in two ways. First, the power of the river to erode decreases as the carrying capacity of the water becomes increasingly taxed; or again the river shortens its course by a cut-off and additional power is given to the flow. Under the action of a meandering stream the upbuilding of the river bed may go on for a season. If the river is kept in a stable channel and the tendency to increasing the radius of meanders on one hand and to cause cut-offs on the other is halted, the actual effect of levees, far

from being a detriment to the channel, is beneficial. Furthermore, it may be expected that, when river regulation has become well established, much of the sediment now given to a stream from insecure banks or unclothed slopes will be eliminated and the power of the stream to deepen its channel will be greatly enhanced.

Summary

The observation of the low water gages of rivers proves quite conclusively that there is no persistent upbuilding of the bed due to levees.

On streams or portions of streams where, from the nature of the conditions, aggrading is in operation, the upbuilding of the river bed after levees have been constructed will probably continue.

Deltas increase in area more rapidly in a leveed river and the increase in the length of the stream diminishes the slope and results in a slight deposit on the river bed. The amount is so small as to be imperceptible during a score of years.

The increase in the height of levees can be accounted for by the success of the engineers in confining an increasing percentage of the flood waters.

The elimination of some of the sediment from a stream flowing through its flood plain will minimize the amount of the temporary deposits in beds of rivers and furnish additional power by which the channel may be cleared of bars.

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GEOGRAPHICAL RECORD

THE AMERICAN GEOGRAPHICAL SOCIETY

The Society's Map Exhibit. A set of economic maps was on exhibition in June in the Society's main hall. The exhibits included excellent maps by leading map makers in various countries. Fundamental facts such as natural resources, great trade routes, etc., affecting industry and commerce are illustrated on these maps. The sheets included "Osbahrs Wandkarte zur Wirtschaftsgeographie der Welt" and "Bambergs Wandkarte zur Kultur- und Wirtschaftsgeographie von Nord- und Mittel-Amerika," both published by Chun in Berlin, the economic sheets of Philip's "Comparative Wall Atlases," representative wall maps from the set edited by Vidal de la Blache, published by Colin in Paris, economic maps published by the United States and Canadian governments, the important commercial and industrial map of European Russia issued by the Ministry of Commerce and Industry in St. Petersburg, and sheets selected from the "Documents Cartographiques de Géographie Economique," published by Messrs. Kümmerly & Frey of Berne. These maps give an idea of the wide range of economic topics which can be represented cartographically.

NORTH AMERICA

Studies in the Yosemite Region. Messrs. F. E. Matthes and F. C. Calkins of the U. S. Geological Survey have returned to the Yosemite region, in California, to resume the geological and geographical studies they began last year. These studies are being made, in part, for the immediate purpose of securing data for a popular yet elaborate account of the mode of origin of the Yosemite Valley, to be published by the U. S. Geological Survey at the time of the Panama-Pacific Exposition next year. In part, also, they are to form the ground work for further research into the geological history of the Sierra Nevada.

Mr. Calkins is devoting himself to detailed petrological and structural studies, while Mr. Matthes is investigating the physiographic problems of the region, more especially those bearing on the evolution of the Yosemite Valley.

The Relief Model of the Yosemite Valley. A large relief model of the Yosemite Valley is being constructed at the Office of Public Roads in Washington for the government exhibit at the Panama-Pacific Exposition in 1915. It is twelve feet long, six feet wide and carries relief to a height of 18 inches. The vertical dimension is not exaggerated, and as a consequence all features are shown in their correct proportions. Indeed, so rugged is the topography of the Yosemite Valley, that any increase in the vertical scale would have resulted in a peculiar, distorted appearance of the great cliffs, domes and spires.

The model is being executed, with painstaking exactness, by an expert model maker, and is based upon the detailed topographic map of the Yosemite Valley, prepared in 1905-06 by Mr. F. E. Matthes of the United States Geological Survey. Portions of this map were enlarged photographically to five times the original scale, that is, to a scale of 400 feet to the inch. The contour lines then were used as patterns for the sawing out of thin wooden boards. These boards were built up in layers and the rough form thus obtained was plastered over with a special preparation of great durability that will bear transportation across the continent.

Large numbers of photographs are being used for local details, and a special effort is being made to reproduce with fidelity the peculiar cliff sculpture which is so prominent a factor in the Yosemite landscape. Inasmuch as these sculptural forms are intimately associated with the lines of structure in

the granites in which the valley lies hewn, the model promises to become an unusually fine medium for the study of these relations of form to structure. Students of geology and geography will therefore, in all likelihood, find it an object worthy of a special visit at the San Francisco Exposition. Explanatory legends will be placed on the sides of the case at various places, directing attention to the most interesting features.

In order to heighten the sense of reality, small streams of water, blown to spray by atomizers, will represent the water falls.

New Slips Along the Fault that Produced the California Earthquake of 1906. This great earthquake, as is known, originated in a movement along the San Andreas fault-rift extending over a distance of 290 miles. Since that year, three slight earthquakes have been traced to slips along the same fault. The first on September 12, 1912, occurred near the south end of San Francisco Bay; the second on October 25, 1913, to the northwest of Berkeley; the third, on January 23, 1914, in an intermediate position close to San Bruno. The epicenter of the last earthquake was determined by Mr. E. F. Davis (*Bull. Seis. Soc. Amer.*, Vol. 4, pp. 25-28) by means of Omori's formula for local shocks, from the duration of the preliminary tremors at the Lick, Santa Clara, and Berkeley observatories.

San Francisco Meeting of the American Association for the Advancement of Science. The American Association will hold a meeting in San Francisco and vicinity on the occasion of the Panama-Pacific International Exposition next year. The meeting will begin on Monday, August 2, and terminate on Saturday, August 7. The general sessions and general evening lectures will be delivered in San Francisco. Addresses and papers in the separate divisions of science will be read chiefly at the University of California, Berkeley, with one day's session at Stanford University. The Pacific Committee on scientific programme suggests that as this meeting will be, in a manner, a part of the celebration commemorating the opening of the Pacific to the peoples bordering the Atlantic, it seems fitting that the programme of meetings should relate as far as possible to problems of world interest which pertain especially to the Pacific area.

Live Stock Among our National Forests. *American Forestry* (Vol. 20, 1914, No. 6, pp. 436-437) says the Secretary of Agriculture has authorized grazing permits for the ranges in the 160 national forests during the present year. Nearly 11,000,000 animals can be grazed, including nearly 2,000,000 head of cattle and horses, nearly 9,000,000 herd of sheep and goats and about 65,000 hogs. For several years the carrying capacity of the national forest ranges has been slowly rising. This indicates an improvement in general grazing conditions and better utilization of the forest resources.

Common Minerals and Rocks. The Colorado State Geological Survey has issued Bulletin 6, "Common Minerals and Rocks; Their Occurrences and Uses," by R. D. George, in which the commoner minerals and rocks are described and the means of recognizing them and knowing their uses are supplied. The handbook presents in usable form the important facts regarding the materials of geology with emphasis on the most useful minerals and rocks. While the book especially applies to minerals found in Colorado, it will doubtless have wide usefulness outside of the state.

Notes from our Coal and Oil Fields. According to the *Press Bulletins* of the U. S. Geological Survey, the production of anthracite again broke the record in 1913, exceeding the highest previous output by nearly 1,000,000 tons. The production was 81,718,680 long tons, valued at $195,181,127, compared with 75,322,855 tons, valued at $177,622,626 for 1912. This is an increase of over 6,000,000 tons in quantity and more than $17,500,000 in value. The previous highest record was 80,771,488 long tons, in 1910.

All previous records in the coal production of Ohio were exceeded in 1913

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both in quantity and value, although coal-mining operations, like other industries of the state, were seriously interfered with by the unprecedented inundation in March and April of that year. The production increased from the previous maximum output of 34,528,727 short tons in 1912, to 36,200,627 tons in 1913, a gain of 1,671,900 tons. The increased value was $2,864,695, from $37,083,363 to $39,948,058.

With a production last year of 70,000,000 tons of coal, West Virginia takes second rank among our coal-producing states. The increased production was well distributed over the state, there being but three counties out of thirty in which there was a decline in output.

During 1913 the Appalachian oil field, embracing New York, Pennsylvania, West Virginia, southeastern Ohio, and Kentucky, showed a slight decline—1.72 per cent.—in the production of petroleum, falling from 26,338,516 barrels in 1912 to 25,885,640 barrels in 1913, a decrease of 452,876 barrels.

Pueblo Indian Maize and the Climate of the Southwest. One of the most important agricultural problems in the United States is the selection and cultivation of the varieties of cereals which are best adapted to our arid regions. Along these lines of investigation our Department of Agriculture has been doing excellent work in recent years. Mr. G. N. Collins, of the Bureau of Plant Industry, in a recent article on "Pueblo Indian Maize Breeding" (*Journ. of Heredity*, Vol. V, June, 1914), points out that the pioneer work of the Hopis and Navajos along agricultural lines has not been sufficiently appreciated, and that many of the facts which we have ascertained by laborious experiment we might have learned by studying the agricultural practices of our own Indians. From prehistoric times, our southwestern agricultural Indians have raised maize successfully in regions where drought, and especially the absence of spring rains, render impossible the growth of many of the common varieties of Indian corn. The peculiar features of the corn used by these Indians is (1) a greatly elongated mesocotyl which permits deep planting, and (2) the development of a single large radicle which descends rapidly to the moist subsoil and supplies water during the critical seedling stage. Thus the long experience of our Indians with the peculiar climatic environment of their own southwestern "desert" gives us something which we, with all our modern experimental methods, have only discovered slowly and with difficulty.

R. DEC. WARD.

The Meteorological Effects of City Smoke. Professor H. H. Kimball, of the U. S. Weather Bureau, has for some years been studying atmospheric transparency in relation to solar radiation amounts, and other effects. Recently he has devoted himself to the city smoke problem. Some results of his work are given in a contribution entitled "The Meteorological Aspect of the Smoke Problem" (*Monthly Weather Review*, Jan., 1914). City fogs are found to be more persistent than country fogs, chiefly because of their increased density, which is due to the smoke that accumulates in them. Hence there are fewer hours of bright sunshine in city than in country. In London, in the clear part of a winter day, the average limit of visibility does not exceed half a mile. It averages about 1½ miles in Pittsburgh, and this is less than one-tenth of the average visibility in the open country around Pittsburgh. The chemical action of light in smoky cities is 40 per cent. less than in the open country, and over 20 per cent. less on smoky days than on comparatively clear days. Minimum temperatures are higher in city than in country. This is due to city heating, in part, and in part also to the blanketing effect of the smoke, which prevents the escape of heat at night. R. DEC. WARD.

Mr. J. B. Tyrrell's Hudson Bay Exploring Expedition, 1912. The report of this expedition appears in the Twenty Second Report of the Ontario Bureau of Mines, 1913. Mr. Tyrrell was instructed to go to Port Nelson, at the mouth of the Nelson River on Hudson Bay, to select the lands and water front to which Ontario was entitled under the agreement with Manitoba, to survey these lands, and to collect all information possible about the

strip of country within 50 miles of Hudson Bay and extending from the southeastern bank of the Nelson River to the western boundary of Ontario. Finally, he was to return home through that part of Keewatin that had been added to Ontario as the District of Patricia, and to learn all he could about its resources and possibilities. He was accompanied by Professor Lewis B. Stewart, of the University of Toronto, as surveyor, Mr. W. B. McPherson, as assistant surveyor and also chainman, and by Indian canoemen. The party started down the Nelson from Norway House, at the north end of Lake Winnipeg, in three canoes. Tyrrell reached Hudson Bay by way of the Nelson and Hayes Rivers, and a large-scale survey of the latter stream was made by Professor Stewart below the junction of the Shamattawa River. A frontage of ten miles on the east side of the lower Nelson, to which Professor Stewart's survey was extended, was marked out with posts and mounds. This is the tract that is to belong to Ontario. A suitable crossing of the Hayes River for the plateau railroad was not found until the party arrived at thirty-three miles above its mouth.

The District of Patricia was so little known that Mr. Tyrrell's work there may be regarded as original exploration. He says the district is a fairly distinct physiographic unit, the rocky granitic plateau, about 1,500 feet high, constituting its highest portion. From this plateau, the district slopes gently southward to Lac Seul and numerous lakes fill the depressions in its rocky surface. Northward, the slope is steeper and here the rock basins are filled chiefly with glacial clays and other surface deposits, a number of lakes occupying depressions in them. This northern country is very new geologically and, as there are no well marked valleys, large areas, having almost no drainage, are covered with peat bogs. The timber supply is not large. A considerable number of Crees and Ojibways are scattered over the district making their staple food of fish. The country at present is uninviting, but, with drainage, it seems to offer agricultural possibilities if the climate, of which little is yet known, is suitable. An extended account of the main rivers and an outline of the geology complete the report.

Revelstoke National Park. The Canadian Government has set aside as a National Park an area of ninety-five square miles in the vicinity of Mt. Revelstoke, on the line of the Canadian Pacific Railway, to be known as the Revelstoke National Park.

Glacial Geology in Canada. The study of the glacial history of the Great Lakes has long needed the correlation of beach levels, not only with outlets, but also with the terminal moraines which mark the positions of ice dams. Progress in this direction has slowly been made in the United States and in Canada. However, the director of the Canadian Geological Survey has recently had F. B. Taylor at work on the glacial deposits north of the international boundary (The Moraine Systems of Southwestern Ontario, *Trans. Canadian Institute*, Toronto, 1913, pp. 1-23.) Taylor shows that, during its recession, the ice was molded into pronounced lobes (a) in the Erie-Ontario and (b) in the Lake Huron basin. The shapes of these lobes at various stages are now defined with considerable accuracy. It begins to look as if stagnant ice lobes, and perhaps even isolated ice blocks, did develop in the basins of the Great Lakes. Besides these two main lobes, a third was subsequently developed in the Lake Simcoe region, east of Georgian Bay. Between the three lobes was an oval area, extending over 100 miles northeast and southwest between Collingwood and London, Ontario. This is designated as Ontario Island. It was uncovered a long time before the Erie and Huron lobes to the southwest had separated, perhaps existing a large part of the time before and during the Maumee and initial Lake Whittlesey stages. Although at one time completely ice-covered, it was more like the Driftless Area of Wisconsin and adjacent states in its origin than the nunataks of the borders of the Greenland ice sheet, for it was deglaciated not because of being high, but because the adjacent lake basins caused the lobate ice sheet to shrink from it rather early in the period of their recession.

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From this detached, ice-free area of Ontario Island, Taylor assumes that a great sub-glacial stream flowed along a crease between the Erie and Huron lobes. Presumably this had much the same relationships as the present Yahtse River between the Guyot and Agassiz lobes of Malaspina Glacier. That it should have emerged as a clear-water stream, as Taylor assumes, seems doubtful.

The several terminal moraines, shown on a good general map, are described in some detail. The waterlaid moraines were lower, smoother, and weaker than those deposited on the land. Some of the latter rise one hundred feet above the adjacent region and are one to three miles wide. The Oak Ridges moraine, north of Lake Ontario, seems to be an interlobate deposit between the Ontario and Simcoe lobes. One of the greatest needs in the glacial geology of North America is the exploratory mapping of the terminal moraines north and east of this area, where Taylor's excellent work establishes a splendid beginning which some of the Canadian geologists may well follow up.

LAWRENCE MARTIN.

CENTRAL AMERICA AND WEST INDIES

A Scientific Study of Porto Rico. The New York Academy of Sciences has begun a scientific study of the island of Porto Rico along the lines of geology, paleontology, zoology, botany, anthropology, and oceanography. With the assistance of a friend, the academy has voted to expend $1,500 a year for five years on this work, and cooperation with the academy has been assured by the American Museum of Natural History, the New York Botanical Garden and by scientific departments of Columbia University, New York University and other institutions. Furthermore, on account of the representations made by the academy through its representatives, Professors Henry E. Crampton and N. J. Britton, the insular government of Porto Rico has made an appropriation of $5,000 toward the work for the fiscal year beginning July 1, 1914, with the expectation that this appropriation would be repeated on each ensuing four years.

The committee having the work in charge consists of Professors N. L. Britton, James F. Kemp, Franz Boas, C. L. Poor and H. E. Crampton. In furtherance of the project Professor Crampton visited Porto Rico in December and January and Professor Britton and Dr. Lutz in January and February last, and the work is now well under way. Some of the aspects of the work are as follows:

Geology: The geological portion of the scientific study of Porto Rico will be begun this summer by Prof. Charles P. Berkey, of Columbia University, who expects to sail for Porto Rico about the middle of August and to spend a month in reconnaissance work on the island. He will probably be accompanied by some other member of the New York Academy of Sciences. Next winter and in subsequent seasons the details of particular sections will be elaborated by other workers, and the mineral resources will be specially studied. Particular attention will also be directed to the fossiliferous strata.

Zoology: The work was begun in January, when Professor Crampton completed a reconnaissance of the island in order to map out the different ecological regions for further intensive study. Dr. Frank E. Lutz was a member of Professor Britton's party which investigated the islands of Desecheo and Mona, as well as certain areas of the main island. His collections comprise 10,000 insects and notable series of land molluscs and other forms. During the present summer Mr. Roy W. Miner will begin the detailed investigation of the invertebrates of the shores and estuaries, especially those of the harbors of San Juan, Ponce, Mayaguez and Vieques. The coral reefs off the southern and western shores will also receive attention. Mr. John T. Nichols will begin the collection and study of the fishes of the same region, working with Mr. Miner so as to correlate the studies in these two fields. Entomology will be in the hands of Messrs. H. D. Barber, F. B. Watson, and Charles W. Leng. They will study intensively certain characteristic regions mapped out by Professor Crampton and Dr. Lutz. The entomologists of government institutions are cooperating with the survey in this department of activity.

Botany: Several of the members of the scientific staff of the New York Botanical Garden have given much time to Porto Rico, and the results of their labors will be used in further research there by them. Dr. Britton visited the island in January and is going there again in August. The field work will be directed more especially to a study of the fungi and the lichens. Much attention will also be devoted to the reforestation of portions of the island, a subject which vitally concerns the welfare of the colony.

Anthropology: No definite assignments have yet been made, but it is hoped to include this branch in the investigation. Although the ethnology of the present inhabitants will be studied, attention will be more particularly devoted to archæology, especially the examination of anciently inhabited caves and the scientific working over of the kitchen middens.

Oceanography: The oceanographical work can also not be carried out immediately. The plans, however, have already been worked out. They include both physical and biological investigations. The physical investigations comprise a study of the tides and of the ocean currents in the neighborhood of Porto Rico, and the biological, deep sea dredging for animal life. For these two branches of oceanographical work it is hoped to send out a specially equipped vessel.

The specimens which are collected will eventually find lodgment in the American Museum of Natural History, except for the "first set" of duplicates. These will be deposited with the authorities of Porto Rico for the inauguration of an insular museum, and the academy's investigators will take particular pains to insure the good quality and extent of this series (*Science*, June 19, 1914, pp. 896-898).

SOUTH AMERICA

The Argentine Instituto Geográfico Militar. The annual report of this institution contains the account of operations for the year 1913. Its text supplements the data submitted in the first volume, recorded in the *Bulletin* (Vol. 45, 1913, No. 3, p. 199). In accordance with the plan for the extension of geodetic operations throughout the country, field work was carried on in the Provinces of Santa Fé and Corrientes as well as in the Neuquén Territory. The Institute is working in close cooperation with various departments in many of the Argentine provinces in order to accelerate its survey operations.

A working arrangement between the Argentine Hydrographic Office and the Instituto Geográfico Militar provides for the extension of triangulation of the first degree to the coast and the tying of coast surveys undertaken by the Argentine navy to the inland network determined by the Institute staff. Photographic surveying was employed extensively. A map in 1:25,000 of Campo General Belgrano and environs, in the vicinity of Salta, was compiled by this method. The data for seven standard sheets of the topographic map of Argentina on this scale were obtained in this manner. A number of maps on various scales were also published, mainly for military purposes. Progress in the publication of the Argentine sheets of the "Carte internationale du monde au millionième" was delayed pending the settlement of details relating to the execution of the sheets.

Rainfall of Southern South America. In extra-tropical South America there are two great currents of air, one northeasterly, from the tropical Atlantic; the other westerly, from the temperate Pacific. Each of these currents precipitates much moisture as orographic rainfall near the coast, and descends on the lee side of the mountains with a considerably diminished vapor content. The northeast current, even after supplying a heavy rainfall on the Brazilian coast, penetrates the continent as a damp wind, the mountains in its path being low, and its capacity for vapor being large. The westerly current from the Pacific loses most of its moisture on the Chilean slopes of the Andes, and on the western Patagonian highlands. The former current supplies moisture for the rainfall of Uruguay, southern Brazil and northern Argentina, and over the narrow strip of the Andean highlands of northern Chile where snow

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and rain occur. The latter current supplies all of Chile with the above exception, and the western half of Patagonia. Between the Atlantic and Pacific rainfall regions there is a semi-arid strip like a long narrow wedge, with the point on the east coast near latitude 48° S., and the base in the extreme north of Chile. The central line crosses the Andes in about latitude 33° S. In this region the rains which do occur affect very limited areas, and are due to purely local disturbances of the atmosphere (H. L. Solyom: "The Rainfall of Southern South America," *Symons' Met. Mag.*, Apr., 1914).

R. DEC. WARD.

AFRICA

Stanley's Chronometer. When Henry M. Stanley completed his exploration of the Congo River he presented the chronometer that helped him to determine positions along his route across the continent to General Strauch, who was later very prominent in the Government of the Independent Congo State. Some time ago, General Strauch presented this interesting souvenir of Stanley's most famous explorations to Mr. A.-J. Wauters, the founder and editor of *Le Mouvement Géographique,* which, for thirty-one years, has supplied the most authoritative and comprehensive record of exploration and progress in the Belgian Congo. Mr. Wauters has long been famous as one of the two or three leading writers on this part of Africa and the many papers from his pen that have appeared in the journal he founded are, to this day, most valuable sources of information relating to this vast and growing colony of Belgium.

ASIA

Dr. F. de Filippi's Asiatic Expedition. The *London Times* prints an extract from a letter written by Dr. De Filippi on March 22 giving some details of the work he proposed to do during the past spring. Writing from Leh, Cashmere, he says he had been there since March 2 arranging for the difficult work of transporting his stores over the Chang La (18,300 ft.) to the Shyok Valley. His party had already done good work that will modify existing ideas as to the construction and geological history of the upper Indus Valley. Many fine photographs had been secured. In April a number of his men were to go to the Rukshu Plains to make gravity observations and he himself intended to proceed to Shyok to arrange for transporting stores to the Dipsang Plains.

AUSTRALASIA AND OCEANIA

Extending British Influence Over the Territory of Papua. The Annual Report of the Government of the Commonwealth of Australia for 1912-1913 on the Territory of Papua, the British possession in New Guinea, says that the scheme for the extension of government influence over the territory has been initiated by the selection of sites on the Fly River and in other regions for government stations. The western part of the territory presents the greatest problem because as yet it is so little known. The object is primarily to put an end to cannibalism, head-hunting and other horrors, the existence of which, it is felt, is a disgrace to an Australian territory. Incidentally it will increase the number of laborers available for employment, but the suppression of crime is the principal object.

EUROPE

Earthquake in Sicily. An earthquake occurred on the southeast flank of Mt. Etna on May 8. It was a strong example of the local shocks often felt within the limits of Etna. For thirteen days slight tremors had given warning and, but for this fact, the loss of life might have been much greater. Over 150

persons, however, were killed and about 500 injured. The villages of Linera, Passapomo, Pennisi and Zerbati were completely ruined and fifteen other villages were half destroyed or seriously damaged.

Mr. C. Davison, writing in *Nature* on this earthquake (May 14, 1914, pp. 272-273), says that the same phenomena seem to characterize all the earthquakes of this district. "The disturbed area is small, the intensity of the shock great in its central portion, and the isoseismal lines extremely elongated in form. In some case the axes of the isoseismal lines are directed towards the central crater; in others (as in the earthquake of 1911) in a perpendicular direction. The small depths of the foci, their situation within the Etnean boundary, and the close connection of many of the earthquakes with eruptions of Etna—all these phenomena point clearly to the volcanic origin of the earthquakes, their immediate cause being probably local slips along radial and peripheral fissures."

Exhausting Russia's Forest Resources. Russia has been commonly reputed to be a country of limitless forests. Last winter, however, the Russian wood famine was so severe that even Moscow suffered from it and some public and charitable institutions were insufficiently heated. The present conditions are narrated for the St. Petersburg *Novoye Vremya* by Mr. Menshikov and a part of his paper has been translated by the *Literary Digest*. He says that, for decades, Russia took no notice of the destruction of the forests. The ruling class, the nobility, sold large parts of their wooded properties rather than sell farm land. Their forests were usually sold for small sums giving the brokers an opportunity to earn 300 to 1,000 per cent. on their capital. In the end the deforestation of the country assumed threatening proportions and the Government finally introduced a forest conservation law. "But . . . the destruction of the forests even now goes on in full blast. The forests which guard the very possibility of man's existence in the north are rapidly disappearing. Firewood is just as vitally necessary to Russia as the sea is to the English and the mountains to Switzerland. One may regret the disappearance of timber, but that can in a large degree be replaced by brick, iron and other construction materials; but fuel in the north, in the form of firewood, cannot be replaced."

Proposed National Oceanographical Institute in Scotland. A movement for the foundation of a Scottish Oceanographical Institute in Edinburgh, to be a memorial to the late Sir John Murray, was inaugurated in the rooms of the Royal Society, of that city, on May 26. The chair was occupied by Prof. James Geikie and among others present were Prof. Sir Edward Schäfer, Dr. W. S. Bruce, Dr. J. G. Bartholomew, Dr. John Horne and others. A resolution that "A permanent foundation of an Oceanographical Institute in the capital of Scotland is highly desirable" was proposed by Professor Geikie and discussed.

Dr. Geikie said that in the Challenger office was housed the finest collection of deep sea deposits in the world. There also were Sir John Murray's extensive library of oceanographical works, probably the best of its kind in Great Britain, and the working machinery in connection with the geological and physical departments of oceanography. Dr. Bruce, on the other hand, had established the Scottish Oceanographical Laboratory at the Surgeons' Hall which contained a large collection of Arctic and Antarctic marine fauna besides collections from the North and South Atlantic Oceans and other seas, as well as what was probably the most complete library of works dealing with the Antarctic. The oceanographical work of Sir John Murray and Dr. Bruce may be said to be complementary, for while the former concentrated more particularly on deep sea deposits and the physics of oceans and lakes, the latter devoted himself more especially to the biological side of oceanographical science. It seemed highly desirable, therefore, that advantage should be taken of the presence of two such well-known laboratories in Edinburgh and that, if possible, they would be conjoined so as to form a permanent oceanographical institute in Scotland. Under Dr. Bruce's charge, this would be a most suitable memorial to his former teacher, Sir John Murray.

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A committee was formed for the purpose of considering how such an institution may best be organized, with power to issue an appeal for funds. The members of the Committee include Lord Stair, President of the Royal Scottish Geographical Society, Prof. James Geikie, President of the Royal Society of Edinburgh, J. Y. Buchanan, of the Challenger Expedition, Dr. W. S. Bruce and others. (Condensed from *The Scotsman*, Edinburgh, May 26, 1914.)

POLAR

Antarctic

The Scottish Antarctic Expedition. *Nature* announces (Vol. 93, April 30, 1914, pp 218-219) that the British Government has refused to honor the application for $19,000 to complete the publication of the scientific reports of the Scottish National Antarctic Expedition of 1902-1904. The application was refused though supported by a very influential body of Scottish scientific opinion. The expedition was entirely equipped by money privately raised in Scotland, though mostly due to the generosity of Messrs. J. and A. Coats. This was the expedition led by Dr. W. S. Bruce, the distinguished polar explorer. His discovery of Coats Land is generally recognized as one of the most important additions to our knowledge of the boundaries of the Antarctic Continent. It added a half million square miles to previous estimates of the area of the continent and settled the position of the coast in the one part where there was no clue to its situation. Its collections and oceanographical observations were of the highest importance. Five volumes of its scientific results have been published and three others have been arranged for by a grant previously made by the Government. Four more volumes are required to complete the series. These volumes were to be devoted mainly to description of the biological collections and memoirs which have already been prepared by many distinguished British and foreign naturalists. Much confusion in biological nomenclature may be produced if the publication of these reports be delayed, so that they fail to appear simultaneously with those prepared from the collections of later expeditions. *Nature* expresses the hope that the Government will reconsider its action.

Shackleton in Norway. Sir Ernest Shackleton with nine members of his expedition have been spending some time in Norway to test provisions and motor sledges for his forthcoming Antarctic expedition.

PHYSICAL GEOGRAPHY

Isostasy and the Size and Shape of the Earth. Mr. William Bowie, of the U. S. Coast and Geodetic Survey, read a paper with this title at a meeting of the American Association for the Advancement of Science at Atlanta on Dec. 29, 1913. It is thus summarized in *Science* (June 12, 1914, p. 882):

"The determination of the size and shape of the earth would be a simple matter if its geoid or sea-level surface formed a geometrical figure, but, as it does not, the actual problem is a difficult one. These deviations, it was shown, are due to differences in the vertical distribution of mass in adjacent isostatic regions. When corrections for the effects of topography and isostatic compensation are applied to the astronomically observed positions the deviation of the geoid from the spheroid surface is largely eliminated.

"The shape but not the size of the earth may be determined from the observed values of the force of gravity at stations widely separated in latitude. Here again a correction for topography and isostatic compensation is necessary for the best results. Absolute values of gravity can be obtained only with a long series of observations, and therefore nearly all gravity determinations are made by the relative method. Those of the Coast and Geodetic Survey are based on the absolute value at Potsdam.

"Investigations made by the U. S. Coast and Geodetic Survey during recent

years show that the area of the United States, taken as a whole, is in a state of perfect isostasy, and that areas of limited extent deviate only slightly from that state. The paper will later appear in full."

PHYTOGEOGRAPHY AND ZOOGEOGRAPHY

The Journal of Ecology. This is a new periodical published quarterly by the British Ecological Society and issued from the Cambridge University Press. The first number appeared in March, 1913. The aims of *The Journal* are twofold: "As the organ of the British Ecological Society, it will endeavor to foster and promote in all ways the study of ecology in these Islands. In the second place, it will endeavor to present, by critical reviews and articles, by full notices of recent ecological publications, and by full lists of current ecological literature, a record of and commentary on the progress of ecology throughout the world."

Most of the space is given to reviews of the literature of ecology. An article on Raunkiaer's "Life Forms" and statistical methods is of especial interest and characterizes the first number. Raunkiaer proposes to limit the domain of geographical botany to "that geographical science which endeavors to characterize the earth by its climate in so far as this is manifested by the adaptation of plants to the various seasons." In other words, the plant itself is taken to be the recorder of the biological value of any climate.

The reviews undertaken by this journal are exhaustive and satisfying. An extensive bibliography of recent literature on ecology is also given. The publication gives promise of filling a long-felt need in a very competent manner.

R. W. SHARPE.

ECONOMIC AND COMMERCIAL GEOGRAPHY

The Panama Canal and World Trade. The economic effects of the Panama Canal have already been much discussed. The *Scottish Geographical Magazine* (June, 1914, p. 327) prints a recent note from the London *Times* dealing with a minor point which shows how complex are the conditions that determine the use of a particular route. The Panama Canal route from New Zealand to Liverpool will shorten the distance by about 900 miles, but the exporters of frozen meat have already decided against using the canal. Ships on the Cape Horn route traverse a long stretch of cold water between New Zealand and the cape, and thence strike almost vertically across the equator. During the passage, the cold storage chambers have to be kept cool, and the higher the external temperature and especially the higher the water temperature, the more power must be expended in the refrigerating process. Ships using the Panama route would cross the equator slantwise, and would be steaming through areas of warm water for a much longer period than at present. It is calculated that, in consequence, the machines would require to be driven for a much longer period each day, and that the increased expenditure on coal, when added to the canal dues and the time spent in traversing the canal, would more than counterbalance the saving due to the lesser mileage. The point is of interest as suggesting that the shortest route is not necessarily the most advantageous route.

Fluctuations in the Yield of Great Fisheries. The Permanent International Council for the Exploration of the Sea has recently issued "Fluctuations in the Great Fisheries of Northern Europe Viewed in the Light of Biological Research" by Johan Hjort (*Rapports et Procès-Verbaux*, Vol. 20, 1914, 228 pp., maps, diagrams). The volume is chiefly given to the Norwegian cod and herring fisheries. The introductory paragraph says:

"From the earliest times, a characteristic feature in all branches of the fishing industry has been the fluctuation of the yields from year to year. At the present time, we find the United States complaining of the failure of the mackerel fishery, while in France, a 'sardine crisis' has arisen, the yield of the sardine fishery, which in 1898 amounted to over 50,000,000 kilos, having

sunk in 1899 to below 30,000,000, and in 1902 to less than 9,000,000 kilos. The Norwegian fisheries, which more especially form the subject of the present work, have for hundreds of years experienced alternating periods of rich and poor yield. These periodical fluctuations have as a rule been of some considerable duration, a series of years of profitable fishery succeeding and succeeded by several years of dearth. Thus the term: a good (or bad) fishery period has become an expression of common occurrence."

PERSONAL

Professor W. M. Davis gave a lecture in the town hall at Suva, Fiji, on April 30 on "The Origin of the Coral Reefs of Fiji," in which he presented the chief results of his seven weeks' visit to those islands as a part of his Shaler Memorial study of coral reefs in the South Pacific. On May 1, he left for New Zealand where he expected to spend the month. His plans were to give June and July to his work in New Caledonia and the New Hebrides, to attend the meeting of the British Association in Australia in August and then go to Tahiti, returning to San Francisco on a steamer due to arrive there on October 29.

Professor N. M. Fenneman, of the University of Cincinnati, is engaged, this summer, in work for the Ohio Geological Survey, chiefly in preparing an educational bulletin on the physiography of a part of southwestern Ohio.

OBITUARY

FERNAND FOUREAU. This distinguished explorer of the Sahara and Governor of the colony of Martinique died in February at the age of sixty-four years. He was one of the most potent influences in securing for France her present prominent position in North and West Africa. Beginning in 1882, he made a series of expeditions into the Sahara, during which he covered with a network of routes the Algerian Sahara, from Insalah in the west, to Ghadames in the east, fixing many positions astronomically, determining altitudes and contributing material for a greatly improved map of the entire region. In 1892 he had reached Timassinin, in 1894, the Tassili on the borders of the Azjer country, and he was incessantly pushing his exploratory enterprises until, in 1898, the French authorities despatched him on the largest expedition that has ever been sent across the Sahara. His baggage camels numbered about 1,000 and he was a year in crossing the desert, having met various difficulties and delays, including some opposition from the Tuaregs. He continued his journey to Lake Chad and the Shari River. By this great journey he opened a way across the Central Sahara to the Sudan and greatly facilitated the extension of French supremacy. Besides publishing a popular account of his last great expedition, "D'Alger au Congo par le Tchad" (1901), he presented, in three quarto volumes, the complete scientific results of the journey. This work is one of the most important authorities on the geography of the Central Sudan.

THE REV. STEPHEN D. PEET, PH.D. Dr. Peet died at Northampton, Mass., on May 24. He was the founder, editor and manager of the *American Antiquarian and Oriental Journal*, which he established in 1878. In 1910, Dr. Peet brought to a close the thirty-two years of his association with this publication. The American Geographical Society, in 1892, elected him as a Corresponding Member.

GEOGRAPHICAL LITERATURE AND MAPS

(INCLUDING ACCESSIONS TO THE LIBRARY)

BOOK REVIEWS AND NOTICES

(The size of books is given in inches to the nearest half inch)

NORTH AMERICA

Early History of Idaho. By W. J. McConnell, who was present and cognizant of the events narrated. 420 pp. The Caxton Printers, Caldwell, Idaho, 1913. $3. 9½ x 6.

The author lived fifty years in Idaho before he wrote this book. He shared in the dangers and hardships of the pioneer days and in the wealth that Idaho has bestowed upon many; and he also served his state as U. S. Senator and Governor. Rich in experiences and in memories, he has written this history of Idaho from the day of the trails, before wagon roads were built, to the admission of the territory into the Union. His story of the fortunes of Idaho, its ups and downs, and its wonderful development is very interesting.

The Canoe and the Saddle, or Klalam and Klickatat. By Theodore Winthrop. To which are now first added his western letters and journals. Edited, with an introduction and notes, by John H. Williams. xxvi and 332 pp. Map, ills. John H. Williams, Tacoma, 1913. $5. 9½ x 6½.

This volume has long been inaccessible, a great loss to admirers of Winthrop, since it is complementary to "John Brent." Winthrop died just when he gave promise of a leading position in American literature. This volume belongs to the period when he was struggling to form a style despite the faults of what then was American literature. To the editor of this volume Puget Sound is a passion and the glimpses of Tacoma are a shrine. Therefore it was to him a labor of love to rescue this work from the oblivion of out-of-print, to annotate its events, to enrich it with pictures. To this he has added Winthrop's journal when on the Pacific Coast and his letters covering the events herein narrated. The region traversed lies across the state of Washington from Port Townsend along the sound and by way of the Naches Pass to the Dalles of the Columbia. The work is one of our original sources for the Chinook Jargon.

WILLIAM CHURCHILL.

A Journey to Ohio in 1810. As Recorded in the Journal of Margaret Van Horn Dwight. Edited with an introduction by Max Farrand. Yale Historical Manuscripts. vi and 64 pp. Yale University Press, New Haven, 1913. 8½ x 5½.

The brief Journal of Miss Dwight's journey from New York to Ohio in 1810 is a human document of rare interest, written day by day on the journey, depicting the difficulties of travel, the roughness of the road, the characteristics of the people met, the regions passed through, ending in the joy of reaching the journey's end. It presents, in a striking manner, a graphic picture of travel a century ago. The descriptions are not without traces of humor, the criticisms are particularly individual, and the little volume is a contribution for an hour's reading that is well worth attention.

RICHARD ELWOOD DODGE.

Chicago and the Old Northwest, 1773–1835. A Study of the Evolution of the Northwestern Frontier, together with a History of Fort Dearborn. By Milo Milton Quaife. 480 pp. Ills., index. University of Chicago Press, Chicago, 1913. $4. 9½ x 6½.

Professor Quaife presents here much wealth of cited material. Two facts are conspicuous in his volume. One is that a narrative can seldom be made

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quite dull when the war whoop and the gleam of the scalping knife must appear on nearly every page; the other is that he has a quick sympathy with the rude life of the pioneer beyond the edges of civilization and also graces of style wherewith that life may be presented for study. He begins with the problem of man always in search of the easy path, in this case the Chicago portage as determining this particular spot as a tradeway and therefore destined to become a market. The chapter in which he discusses the portage leaves nothing to be desired for the purposes of the geographer. Every memorial of the past has been ransacked for its description and every narrative has been duly weighed as to its credibility, every point sedulously oriented upon the natural features of the two rivers (the Des Plaines and the Illinois) and Mud Lake which set Chicago apart for a metropolis. The remainder of the work,—it ends with the close of the Black Hawk war and the beginning of the modern era of Chicago,—is food for the historian, but the opening chapters are proper subjects of a geographical review. They are excellently done and must stand as the most accurate statement of the situation and causes of the founding of the great city on the lakes. The empire of steam continues Chicago, but here we see that Chicago was marked out by nature for a metropolis by reason of the fact that its Mud Lake afforded the shortest and easiest pathway between Canada and Louisiana, the spot where canoes could be floated and dragged over a few miles of portage between the St. Lawrence and the Mississippi.

The Spanish Archives of New Mexico. By R. E. Twitchell. Vol. I. (In the office of the Surveyor-General, Santa Fé, New Mexico.) xxiii and 525 pp. Map, ills., index. Vol. II (In the Library of Congress, Washington, D. C.). vi and 682 pp. Map, ills., index. The Torch Press, Cedar Rapids, Iowa, 1914.

A valuable list of New Mexican historical documents dating from the year 1621 to the American occupation. The compilation deals with Spanish colonization and the wars between Indians and Spaniards. It is particularly useful in the glimpses it affords of the condition of the Indians during the progress of settlement by Spaniards. Although the work contains no reference to the earliest exploration of the region, titles relating to the period covered are abundant. They are accompanied by concise summaries of the contents of the documents enumerated. Perhaps many of the users of these volumes would prefer having the contents merged into a single chronological list. A letter or symbol might have accompanied each title to designate the repository of the document.

The Old Spanish Missions of California. An historical and descriptive sketch. By Paul Elder. vi and 90 pp. Ills. Paul Elder & Co., San Francisco, 1913. $3.50. 11 x 8½.

The cult of the Franciscan missions is a modern affair in California. In the late '80s no Californian ever gave a thought to the missions except as survivals from a sluggish, preceding civilization which he wrote Mexican and for the most part pronounced Greaser. But with the commercial possibilities of winter tourist traffic California awoke to its missions as a visible asset and has exploited them with great success. We cannot avoid the fact that these structures were erected by inartistic missioners from country rock and clay with the help of ignorant Indians, the sole aim being utilitarian. A pale Melrose moonlight is an essential to viewing them aright. It is such a light that Mr. Elder has succeeded in casting on these more or less crumbling ruins in a series of extremely beautiful photographic prints and a text such as might be expected from perhaps our most successful artist in type. Here we have the missions at their best, a work invaluable for the traveler as he follows the holy path of the Camino Real from San Diego de Alcalá to the Mission Dolores and across the straits to San Francisco Solano. For those who may never make the pilgrimage this handsome volume will offer the best information, albeit nothing can give the distant reader the stimulus of the Californian air which always inspirits and at its worst, say at the end of a three days norther, fairly intoxicates. WILLIAM CHURCHILL.

The Rainfall of California. By A. G. McAdie. Maps. *Univ. of California Public. in Geogr.*, Vol. 1, 1914, No. 4, pp. 127-240. Berkeley. $1. 11 x 7½.

An excellent, clean-cut and readable monograph comes as a fitting contribution from Professor A. G. McAdie at the end of his long term of service as local forecast official of the Weather Bureau at San Francisco. It is a satisfaction to see the emphasis which is here laid upon the conditions and controls of rainfall, instead of the usual method of presenting only the bare facts of amounts and distribution. The author clearly brings out the importance of the control exercised by the permanent centers of action, as well as by the temporary cyclones and anticyclones. In other words, weather is here considered, as well as climate. We note, *e. g.*, charts of sea-level pressures and of the paths of low and high areas in typical "wet" and "dry" winter months. The excess of rainfall in one of the former was approximately 43,000,000 acre feet, and the deficiency in one of the latter was about 33,000,000 acre feet. The economic significance of such conditions is easily appreciated.

We are glad to note the emphasis laid upon topography, and to see photographic reproductions of models of California and of southern California. Such illustrations are a great help to those who are studying the data contained in the report. Special attention is paid to the long-period record for San Francisco; to the variation of rainfall with altitude, and to the snowfall at Summit, for which station there are thirty-five years of observations. The annual amount of snowfall at this place has twice exceeded 775 inches in thirty-five years. There is an interesting discussion of the rate of snow melting, and Fig. 10 shows a photograph of a highly ingenious model, devised by Professor McAdie, which has made possible a comparison of the actual curve of melting for any given season with the mean curve, so that the probable date of the snow's disappearance may be determined. A chart shows the rainfall of California on the basis of thirty years of records, and the monthly distribution of rainfall at selected stations is shown in a diagram. Other illustrations are of the prevailing winds of the Pacific Ocean, and of the ocean currents off the coast of California. Detailed studies of this kind are needed for every state in the Union. R. DeC. WARD.

Report of the Meteorological Station at Berkeley, Cal., for the Year ending June 30, 1913. By William G. Reed. *Univ. of Cal. Public. in Geogr.*, Vol. 1, 1914, No. 6, pp. 247-306. Map, ills. 60 cents. 10½ x 7.

Mr. Reed's report of the University of California meteorological station is a model one in every respect. Complete, systematic, thoroughly up with the times, it might well be taken as a pattern for similar reports elsewhere. Among the many features which especially deserve attention and commendation are the careful description of the instruments and of their exposure (the latter clearly illustrated by three contour maps and four photographs); the adoption of the new C. G. S. units; the clear tabulation and discussion of the cyclonic control and classification of the rainfalls—a sadly neglected and most essential feature in meteorological and climatic summaries; and, finally, the excellent diagrams. R. DeC. WARD.

Summaries of Climatological Data by Sections. Vol. 1: Sections 1 to 57, inclusive, embracing the sections west of the Mississippi River. Vol. 2: Sections 58 to 106 inclusive, embracing the sections east of the Mississippi River. Maps, diagrams. *Weather Bur. Bull. W.* Washington, 1912. 11½ x 9½.

Whenever a large amount of statistical data of any sort has been collected, it is a great help to have them summarized in compact and serviceable form. *Bulletin W* contains all the essential climatological data of the United States which are likely to be needed for everyday use by those whose work or interests concern our climate. A very large mass of numerical material is here brought together in a convenient form for ready reference, and

most of the questions concerning climatic conditions in the United States which are daily asked by hundreds of persons here find an answer. The country is divided into 106 "climatological sections." For each section there is a well-considered brief summary of the topographical and the climatic features. Then follows a compact digest of the climatological material which has accumulated during the last half-century, not alone by averages for the whole period, but, for the most important data, by individual months and years as well. Monthly and annual amounts of precipitation, averages and extremes of temperature, frost data, wind velocity and direction, and other information, are presented for each station which has a record long enough to give a fairly accurate picture of the actual climatic conditions. Where data are available, a summary (furnished by the U. S. Geological Survey) gives some of the broader facts regarding the average, maximum and minimum discharges of the principal rivers and streams; the possibilities of water storage, power development, and other details useful to engineers. For each section there is also a full page of diagrams showing the comparative monthly distribution of precipitation at selected stations. These diagrams illustrate very clearly the occurrence of wet and dry seasons, and the local variations in rainfall due to topography and general environment. One of the most useful features is the contoured topographic map of each section, showing the location of the stations and of the principal rivers. These maps supply a need which has long been felt by all those who have had occasion to work on our climatological data. The period covered by the data varies. For most sections the last year in the tables is 1908. In some cases it is later (1909 or 1910). The *Annual Reports of the Chief of the Weather Bureau* will hereafter contain the continuations of these data. It was the intention of the Weather Bureau to give a history of the climate of the United States in as convenient a form for reference as possible. This object has been successfully attained. On the library shelves of every teacher and student of American climatology, and within easy reach of his hand, *Bulletin W* will hereafter be found, next to Professor A. J. Henry's "*Climatology of the United States*" (*Bulletin Q*, 1906).

R. DEC. WARD.

The Natural History of the Toronto Region, Ontario, Canada. Edited by J. H. Faull. 419 pp. Maps, ills., index. Canadian Inst., Toronto, 1913. $2. 7½ x 5.

This book was prepared for the Twelfth Geological Congress, and for all who are interested in the history and natural history of Toronto and vicinity. The work consists of articles contributed by specialists in their respective fields. The last chapter is devoted to a description of the points of scientific interest near Toronto, and how to reach them. There are a number of illustrations and maps; and in the pocket are three larger, unbound maps, for field use, of the county of York and portions of the adjacent counties of Peel, Halton, Simcoe and Ontario; the counties of Lincoln and Welland with portions of Halton, Wentworth and Haldimand; and Toronto and environs.

WILBUR GREELEY BURROUGHS.

New England and New France. Contrasts and Parallels in Colonial History. By James Douglas. x and 560 pp. Maps, ills., index. G. P. Putnam's Sons, New York, 1913. $3. 9 x 6.

A native of Quebec, reared on the scene of memorable events, the author became a mining engineer, gained fame in his profession, and acquired in spare moments a ripe knowledge of the history of his native region. This work of sound erudition has grown out of these combined elements. Using the most reliable documents available he has brought to his book originality of touch by his clear comprehension of the economic causes affecting the events of the period he treats. A lifetime of important association with one of the greatest of American industries has been a valuable asset in the preparation of his work. He has spared no pains in research. The high-spirited French colonists are vividly contrasted with the unemotional and matter-of-fact English settlers. Well-chosen quotations from diaries and journals give clear ideas of the colonists' daily life.

LEON DOMINIAN.

CENTRAL AMERICA AND WEST INDIES

Panama. The Creation, Destruction, and Resurrection. By P. Bunau-Varilla. xx and 568 pp. Ills., index. McBride, Nast & Co., New York, 1914. $3.50. 10 x 6½.

The main purpose of this large book seems to be "The Vindication of French Genius" as related to the Panama Canal, and enthusiastic display of the preeminent contributions of the author to this result. He says that the Panama Canal has been realized "by the methods and the plans which the French mind had conceived, though not by the methods it had finally evolved." On page 3 he says:

"My efforts brought about the defeat of the Nicaragua project and its rejection by the nation [the United States] which had conceived it half a century ago and had cherished it ever since.

"My efforts brought about the changes in the political map of Central America.

"My efforts brought about the creation of that new Republic of Panama without which the French enterprise would to-day be dead and forgotten. Thanks to the Republic of Panama it is on the point of completion."

ASIA

The Cochin Tribes and Castes. By L. K. Anantha Krishna Iyer. Vol. 1: xxx and 366 pp. Ills., index. Vol. 2: xxiii and 504 pp. Ills., index. Higginbotham & Co., Madras, 1912. 9½ x 7.

It is probable that interest in this work will center most largely about the first five chapters of Vol. 2, for in that part of the investigation we have such a story of the Nayars as may nowhere else be found. The particular importance of the Nayars in ethnography is that they practice a form of polyandry so different from that in use in Tibet that polyandry makes its first classification under the designation Tibetan and Nair respectively, for we note that until the appearance of this study the tribal name was spelled Nair. For the first time we now have a reasonably clear explanation of the causes out of which has arisen this type of family establishment. We see how suited it is to the social conditions in which it is found and how it works for the improvement of the moral life of the community quite as much as does polygamy in other social conditions. WILLIAM CHURCHILL.

Scinde in the Forties. Being the journal and letters of Col. Keith Young. Edited by Arthur F. Scott. xvi and 201 pp. Map, ills. Constable & Co., London, 1912. 12s. 6d. 9½ x 6.

The volume shows something of the work of reconnaissance and service travel which cleared the way for the great Trigonometrical Survey of India. Colonel Keith Young, then a captain in one of the East India Company's regiments, was sent to Scinde shortly after its capture by Sir Charles Napier. For the better part of ten years he served as Judge Advocate General in the difficult task of attempting to do British justice among a people whose moral sense had developed along quite other lines. His work gave such satisfaction that he was continued in the same employment under Sir Bartle Frere after the retirement of Napier. It is not difficult to discover in his narrative the grievances out of which was to arise in a few years the great mutiny which put an end to the Company rule.

Glimpses of Indian Birds. By Douglas Dewar. xiv and 266 pp. Index. John Lane Co., New York, 1913. $2.50. 9 x 6.

Various birds of India are considered one by one, a rather minute description of their appearance, habits, surroundings, etc., being given. Mr. Dewar's statements are based on his own personal observations, and his findings are original. Indeed, he vehemently attacks many prevalent theories of protective

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coloration, the power of animals to think, to reason, to express thought, and kindred subjects. On page 47, he advances a subject for further investigation. He writes: "The correlation or interdependence of various characteristics and organs is a subject full of interest, but one which has hitherto attracted comparatively little attention. Close study of this phenomenon may eventually revolutionize zoological thought."

The book lacks illustrations. If each bird described could, in addition, have been brought before the reader by means of good photographs, the work would have been enhanced in value. As it is it is worthy of attention.

WILBUR GREELEY BURROUGHS.

Java and her Neighbours. A traveller's notes in Java, Celebes, the Moluccas and Sumatra. By A. S. Walcott. xvii and 350 pp. Map, ills., index. G. P. Putnam's Sons, New York, 1914. $2.50. 7½ x 5½.

Introduced by a carefully compiled and well written historical sketch of the Dutch East Indies. The book is intended for the general reader but is not superficial; clearly describes the things best worth attention in the islands visited; entirely subordinates the personality of the author with which too many books of travel are suffused. There are a good index and many excellent illustrations.

Seventeen Years among the Sea Dyaks of Borneo. A record of intimate association with the natives of the Bornean jungles. By E. J. Gomes. xx and 343 pp. Map, ills., index. Seeley & Co., London, 1911. 16s. 9 x 6.

The tribe discussed in this excellent record of mission endeavor is the Iban of Hose and McDougall's classification. Mr. Gomes regards them as an inclusion of an earlier race persisting through a later Malayan wave of settlement. This is open to doubt, in fact the probability is opposed to this conclusion. In the wider study of Indonesia we are led to the belief that in its pigmy Negrito folk we have a survival from one of the foci of human evolution, the discovery of Pithecanthropus by Dubois in this horizon being peculiarly enticing. Postulating information, at present very imperfect, we incline to see in the Punan of the mountains of Borneo a member of this truly autochthonous race. We are in a position to deny the statement as regards the Iban. Recent linguistic research in the Philippines establishes their close agreement with the Subanu, therefore with an early eastern wave of the first Malayan migration over Indonesia coincident with, and operative upon, the expulsion of the Proto-Polynesians, themselves the colony of a migrant swarm. Mr. Gomes is an excellent reporter of manners and customs with which he has had the opportunity and the sympathy to become quite familiar. His volume stands to the work of Hose and McDougall as the expansion of a particular chapter.

WILLIAM CHURCHILL.

Japan's Inheritance. The country, its people, and their destiny. By E. Bruce Mitford. 384 pp. Ills., index. T. Fisher Unwin, London, 1913. 10s. 6d. 9 x 6.

In reference to the political chapters of this work we observe that the author has arrived at the third stage of comprehension of Japan as an Asiatic power and a factor in world power. He blends admiration and condemnation in such wise as to give value to the expression of his opinions as an interpretation of modern Japan. In this particular it is but one of several authoritative books. The true novelty which Mr. Mitford offers is a brilliant study of Japanese landscape as the resultant of tectonic forces. He points out the most beautiful scenes of the Island Empire, he analyzes their beauty with the skill of a painter, he criticises the Sankei which Japanese taste has picked as the three landscape gems, Miyajima, Ama-no-hashidate and Matsushima. With no little skill in the understanding of the constructive force of the plastic dejecta of volcanoes he traces the series of events. So far as is possible he recovers the ancient land surface as basic in the study of the modern

scene. He continues this study through the period of active vulcanism, the disruptive force applied from below upon the ancient anticlines, the deposit of the volcanic overload. The third stage is the aging of the new land form, the weathering and stream erosion. It is rare that we find so much enjoyment in the charm of landscape associated with such skill in the analysis of its structural composition. WILLIAM CHURCHILL.

EUROPE

The Highways and Byways of England. Their History and Romance. By T. W. Wilkinson. xxiii and 270 pp. Ills. Iliffe & Sons, London, 1913 (?) 4s. 6d. 7½ x 5½.

Beginning with the earliest tracks for travel, prior to the Roman Conquest, and continuing to the present day of good roads due to the coming of the automobile, the author shows how the roads of England with their erratic lines, severe gradients, narrowness, and sinuosity, breakneck hills, and dangerous corners were made so, nearly as often from choice as from necessity. But this history of the roads deals with other phases of the subject beside the highway proper. It deals with the part played by roads in history, the account being made more vivid by the narration of specific incidents; the relation of roads to social and commercial progress; and through the lessons taught by the past, we are shown the best methods of improving and utilizing the highways of England for the future. Numerous photographic illustrations give the book an added value. WILBUR GREELEY BURROUGHS.

The Survey Gazetteer of the British Isles, Topographical, Statistical and Commercial. Compiled from the 1911 census and the latest official returns, edited by J. G. Bartholomew. viii and 756 pp. With appendices and atlas. J. Bartholomew & Co., Edinburgh, 1914. 15s. 10½ x 7½.

A new edition so thoroughly revised as to make the book, to a large extent, a new work. It contains some 12,000 additional entries, though by the use of smaller type and condensation of the longer articles the bulk of the volume is reduced. The largest political units as England, Wales, etc., are not treated, but there is great variety of condensed information as to all the smaller units down to the hamlets. The broad lines of geological structure are given for the counties. The appendix contains the etymology of British places names, statistical tables and forty-seven pages of maps of the British Isles, on a scale of 1:633,600 (10 miles to an inch) showing all place names, roads, canals, etc. Political coloring only is used and topography is indicated only by many hundreds of heights in feet.

The Birmingham Country. Its Geology and Physiography. By C. Lapworth. 53 pp. Maps. Cornish Bros., Ltd., Birmingham, 1913. 2s. 6d. 8½ x 5½.

Prepared as a guide for the use of the members of the British Association for the Advancement of Science during their visit to the Birmingham country in 1913. A good description of the geology of the region and of its physiography in the British sense of that word (a general description of the drainage divides, the hills and uplands and the rivers and lowlands without reference to the stages of their genesis). A capital little book to have in hand if a visitor desires to gain more than a superficial impression of this area.

The Place-Names of Nottinghamshire, their Origin and Development. By H. Mutschmann. 179 pp. University Press, Cambridge; G. P. Putnam's Sons, New York, 1913. $2.50. 8½ x 5½.

An interesting study of the origin and development of place names. Thus the name Nottingham seems first to have been Snotingaham (A. D. 868), Anglo-Saxon, meaning the homestead of the family of Snot. In the twelfth

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century, under Anglo-Norman influence, the S was dropped and the name became Notingeham; and variations of these Anglo-Saxon and Anglo-Norman spellings during all these centuries are adduced. The field of place-name research presents many pitfalls and dangers and the author of this painstaking study claims nothing more for it than that it may afford instruction to some and "that the theories—often very bold—propounded in the book may draw valuable comments from its critics."

The Place-Names of Oxfordshire, their Origin and Development. By Henry Alexander. With a preface by H. C. Wyld. 251 pp. Clarendon Press, Oxford, 1912. 5s. 8 x 5½.

Enumerates all the examples of popular etymology and notes the influences of Norman French spelling and other points of general philological interest. The place names of about a dozen English counties have now been subjected to similar investigation and the work is in progress in four other counties.

L'Archipel de la Manche. By Camille Vallaux. 256 pp. Collection des Voyages Illustrés. Map, ills. Hachette & Cie, Paris, 1913. Fr. 4. 7½ x 5.

This well-stocked volume on the Channel Islands contains an interesting history of the people, and their customs old and new. Historically the islands belong to England but geographically they are nearly identical in their fauna and flora with the nearby continent and at one time were undoubtedly part of the mainland. The density of population is 380 to the square kilometer, as populous as the industrial and mining districts of Westphalia or Lancashire. The cattle of Jersey and Guernsey, of course, receive due attention. These famous cows are the largest factor in the export trade from the two islands, and the United States takes the greater part of them. Through extensive farming, the people of Guernsey, and Jersey especially, have readjusted themselves to the resources of their islands which were very little known fifty years ago. This little book will be of interest to all who contemplate a trip to these picturesque islands. Much condensed guide book information is given at the end of each chapter and this, with its legendary, geographical and historical phases, makes the book very helpful. It is profusely illustrated and has a small scale map.

A. C. Bartlett.

Les Divisions Régionales de la France. Leçons faites à l'École des Hautes Études Sociales. Par P. Vidal de la Blache, C. Bloch et al. 260 pp. F. Alcan, Paris, 1913. 6 Fr. 8½ x 5½.

Geographical conditions prevailing in France at the time of the revolution are compared with changes due to modern activity. The criteria available for territorial partitioning are shown to resolve themselves into numerous factors among which improvement in transportation methods, growth of urban agglomerations or the development of seaports are of prime importance. The work deserves distinction because it leads to the conception that geographical unity does not depend on mere physiographic delimitation but that it is subject to varied influences. Each qualifying condition may serve for regional demarcation within its own particular sphere. It is only the group, however, which may be considered in singling out a geographical region.

Leon Dominian.

OTHER BOOKS RECEIVED

These notes do not preclude more extended reference later

NORTH AMERICA

American Game Birds. By C. A. Reed. 64 pp. Ills., index. C. K. Reed, Worcester, Mass., 1912. 60 cents. 7 x 5.

American Permian Vertebrates. By S. W. Williston. 145 pp. Ills., index. Univ. of Chicago Press, Chicago, Ill. $2.50. 10 x 7.

DAS DEUTSCHTUM IN DEN VEREINIGTEN STAATEN in seiner Bedeutung für die amerikanische Kultur. Von A. B. Faust. 447 pp. Index. —— in seiner geschichtlichen Entwickelung. 504 pp. Index. B. G. Teubner, Leipzig, 1912. 9 x 6½.

THE FREIGHT CLASSIFICATION AND TRAFFIC TERRITORIES OF THE UNITED STATES. By E. S. Ketchum and T. D. Fitzgerald. 57 pp. Map. U. S. Commerce Assoc., Chicago, 1913. $1. 9 x 6.

HISTORY OF THE CITY AND COUNTY OF SCHENECTADY, N. Y. Originally prepared in 1887 for use in the public schools of the city, now revised and brought down to date. 46 pp. [Publisher not given]. Schenectady, N. Y., 1913. 75 cents. 6½ x 5.

THE MAKING OF CANADA. By A. G. Bradley. viii and 396 pp. Map, index. Constable & Co., London, 1908. 5s. 9 x 6.

SOUTH AMERICA

LA REPÚBLICA ARGENTINA. Impresiones y comentarios. Por A. Posada. xi and 481 pp. V. Suárez, Madrid, 1912. 9 x 6.

BRASILIEN: EIN LAND DER ZUKUNFT. Von H. Schüler. 2nd edit. xii and 479 pp. Map, ills. Deutsche Verlags-Anstalt, Stuttgart, 1912. 9½ x 7. 10 x 7.

DAS MODERNE BRASILIEN in seiner neuesten wirtschaftlichen Entwicklung. Von E. Dettmann. xii and 486 pp. Map, ills. H. Paetel, Berlin, 1912. 10 x 7.

IN CHILE, PATAGONIEN UND AUF FEUERLAND. Ergebnisse mehrjähriger Reisen und Studien. Von S. Benignus. 369 pp. Maps, ills. D. Reimer (E. Vohsen), Berlin, 1912. 10 x 7.

AUS CHILES VERGANGENHEIT. Plaudereien von A. Wilckens. 108 pp. Imprenta Victoria, Valparaiso, 1913. 8 x 5½.

THE WILDS OF PATAGONIA. A narrative of the Swedish expedition to Patagonia, Tierra del Fuego and the Falkland Islands in 1907-1909. By C. Skottsberg. xix and 336 pp. Maps, ills., index. E. Arnold, London, 1911. 9 x 6.

AFRICA

ALONE IN WEST AFRICA. By M. Gaunt. 3d edit. xix and 404 pp. Ills., index. T. Werner Laurie, London. 15s. 9 x 6.

IM AUTO QUER DURCH AFRIKA. Von P. Graetz. 357 pp. Map, ills. Braunbeck & Gutenberg, Berlin, 1910. 9½ x 6½.

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NEW MAPS

EDITED BY THE ASSISTANT EDITOR

For system of listing maps see p. 74 of this volume

SOUTH AMERICA

Argentina-Chile. Mittel Argentinien und Mittel Chile zwischen 26. und 35. Grad südl. Br. nach den neuesten Quellen bearbeitet, herausgegeben von Prof. Dr. R. Jannasch. Ausgabe 1912. 1:1,000,000. 26° - 35° S.; 72¼° - 55⅖°. 4 colors. In 4 sheets. Engraved by Lith. Anst. v. Leopold Kraatz, Berlin. Price M. 30.

[Valuable map on a relatively large scale based on all of the sources available. Relief is in brown shading, drainage in blue. Railroads, in operation and projected, and roads, main and secondary, are shown. There are six symbols for towns and other settlements; why their explanation is in Portuguese, while the rest of the legend, as is to be expected, is in Spanish, does not appear. The boundaries of many land grants and *colonias* are shown. The choice of the millionth scale is a felicitous one, as, for this economically so important region of South America, the map thus anticipates, in a way, the publication of the relevant sheets of the International Map of the World, some of which, to be sure, have already been issued, in a preliminary edition at least, within the area covered by the map, viz.: South H 19, I 18 and 19, for Chile, and G, H and I 21 for Argentina.]

AFRICA

Sahara. Der Stand der Erforschung der Libyschen Wüste und Tibestis, Anfang 1914. Entworfen von Ewald Banse. 1:7,500,000. 32° - 14° N.;

12½° - 34° E. 5 colors. Accompanies, as Taf. 23, "Der gegenwärtige Stand der Erforschung der Libyschen Wüste und Tibestis: Unterlagen für ein Erforschungsprogramm des letzten grösseren weissen Flecks in Afrika" by E. Banse, *Pettermanns Mitt.*, Vol. 60, I, 1914, March, pp. 137-142, April, pp. 193-196, and May, pp. 261-264.

[Important map embodying all known information with regard to this, the largest area in Africa remaining unexplored. The area never visited by Europeans is left white in contrast to the surrounding known regions in buff. Around the border of this white area are shown, in red, the routes of the travelers who have most nearly encroached upon it. Within the unexplored area are shown all the topographical features known from hearsay, mainly from native report, such as oases, caravan routes, and *wadis*. The map thus shows at a glance what we know about the region and what we do not. The value of such surveys has previously been dwelt upon in reviewing Cana's excellent map showing the progress of exploration of Africa (cf. under "Africa," *Bull.*, Vol. 44, 1912, p. 78). The present map was compiled and the accompanying paper written in preparation for an expedition which the author proposed to carry out to penetrate into the unknown area (see "Record" in June *Bull.*, Vol. 46, 1914, p. 442). This postulate of original exploration—familiarity with previous work in the same field—is unfortunately not always met as satisfactorily by many modern explorers as it has been in this case.]

Sahara. Mission du Transafricain, Janvier-Novembre 1912: Esquisse orographique du Sahara central par le Capitaine Nieger, Chef de Mission, d'après les documents recueillies par la Mission et la carte au 1: 1,000,000e du Sahara en cours d'exécution au Service Géographique de l'Armée. 1:4,000,000. 28½] - 12] N.; 4° W. - 17½° E. 5 colors. With inset of western Africa [1:38,000,000], 2 colors, showing location of main map and connecting railroad systems. Accompanies, as Pl. 1, "Résultats scientifiques d'ensemble de la mission du Transafricain" by Capt. Nieger, *La Géogr.*, Vol. 29, 1914, No. 2, pp. 73-113.

[Important general map of the Central Sahara embodying the results of all the recent explorations of the French Army and based more particularly on the eight-sheet map of the Sahara, 1:1,000,000, in course of publication by the Service Géographique de l'Armée. Relief is shown in contours in brown (interval, 100 meters), escarpments being brought out in hachuring in violet. Drainage is in blue, the main *wadis* being shown in stippling; areas subject to inundation in the rainy season (in the transitional area bordering on the Sudan) and *sebkhas* (salt flats) are also differentiated. The mobile dunes of the Sahara are distinguished in buff. In red is shown the route of the projected trans-Saharan railroad (cf. "Record" in May *Bull.* [Vol. 46, 1914], pp. 366-368). The map brings out especially well the inclined plateaus generally terminating in abrupt escarpments on one side which characterize the Central Sahara (contrary to former belief, which conceived of the Sahara as one vast sand desert), such as the Tademait, Tidikelt, Ahnet, Mouydir, Tasili of the Azjers, and the massifs of the Ahaggar, Adrar and Aïr.]

ASIA

Arabia. Northern Arabia: Sketch Map to illustrate the journey of Capt. G. Leachman (Royal Sussex Regt.), 1912. 1:5,000,000. 34¼° - 23° N.; 34° - 51° E. Accompanies "A Journey through Central Arabia" by G. Leachman, *Geogr. Journ.*, Vol. 43, 1914, No. 5, pp. 500-520.

[Contains, with other information as to the adjoining region, the results of Capt. Leachman's important journey from Damascus east and then southeast across the Syrian Desert and the Nefud via Boreida and Riadh to Bahrein Island in the Persian Gulf.]

Burma. Sketch map showing the route followed by Captain B. E. A. Pritchard from Myitkyina to Sadiya, 1911-1912. 1:3,000,000. 28° - 25¼° N.; 95½° - 99° E. With inset, 1:90,000,000, showing location of main map. Accompanies, on p. 525, "A Journey from Myitkyina to Sadiya viâ the N'mai

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Hka and Hkamti Long'' by B. E. A. Pritchard, *Geogr. Journ.*, Vol. 43, 1914, No. 5, pp. 521-535.

[Route led through ill-known territory up the eastern branch of the Irrawaddy to near its head and across the divide to the Brahmaputra at the head of the Assam lowland.]

Turkey in Asia. Reise von Môsul nach Aleppo. Originalroutenkarte in drei Blättern aufgenommen von Dr. Walther Hinrichs. [Three sheets:]

Blatt I [in two parts:] Ia. Route Môsul bis Bezâr. 1:300,000. 37°10′ - 36°17′ N.; 41°42′ - 43°15′ E. 3 colors. With three insets of places on the route, 1:100,000, approximately: (1) Bawârda. (2) Tell Rumelân. (3) Gebl Batme. Ib. Route von Bezâr nach Ras el Ain. [1:300,000]. 37°26′ - 36°37′ N.; 40°8′ - 41°45′ E. 3 colors. With five insets of places on the route, 1:100,000, approximately: (1) Ahlêli Tepe. (2) Serdjechan. (3) Dêr Tschômere. (4) Marbâb. (5) Kinik.

Blatt II. Route von Ras el Ain zum Euphrat. 1:300,000. 37°1′ - 35°47′ N.; 38°34′ - 40°9′ E. 3 colors. With inset: Übersicht des Reiseweges von Môsul nach Aleppo. Von Dr. Walther Hinrichs. 1:3,700,000. 40° - 34° N.; 34° - 44° E. 3 colors.

Blatt III. Route vom Euphrat bis Aleppo. 1:300,000. 37°26′ - 35°45′ N.; 37°2′ - 38°35′ E. 3 colors.

Accompany: Blatt I, as Taf. 33; Blatt II and III as Taf. 34 and 35, respectively, ''Eine Karawanenreise von Môsul nach Aleppo vom 9. März bis 25. April 1911'' by W. Hinrichs, *Petermanns Mitt.*, Vol. 60, I, 1914, April, pp. 189-193, and May, pp. 257-259.

[Valuable compass survey of route leading through rarely frequented district along the northern edge of the Mesopotamian plain. Relief in brown, perennial streams in blue, *wadis* in black, author's route in red. Inset on Blatt II shows the extent and location of the individual sheets.]

AUSTRALASIA AND OCEANIA

Australia. (a) Sketch map of the present drainage of the region surrounding the [Federal] Territory. 1:2,000,000. 34⅜° - 36½° S.; 148° - 150⅝° E.

(b) The ancient river systems, before the period of extensive faulting and folding which led to the capture and reversal in most of the rivers and moved the coast line considerably to the west. Scale and limiting coordinates as on map (a).

(c) Map correlating the chief seismic area of New South Wales with the anomalous river evolution of the region. 1:4,000,000. 33° - 37⅜° S.; 147¼° - 152° E.

(d) Mean annual rainfall in region around the Federal Territory. From map by the Commonwealth Meteorologist. 1:4,000,000. 34° - 37½° S.; 147° - 151¼° E.

(e) Departmental plan of the new Commonwealth capital Canberra. 1:60,000. [36°18′ S. and 149°8′ E.]

Accompany respectively as Figs. 10, 11, 12, 13, and 14, on pp. 538, 539, 540, 542 and 548, ''The Evolution of a Capital: A Physiographic Study of the Foundation of Canberra, Australia'' (conclusion) by G. Taylor, *Geogr. Journ.*, Vol. 43, 1914, No. 5, pp. 536-554.

[The remaining figures illustrating Griffith Taylor's paper, the first of which were listed under ''Australia'' in the July *Bull.* (Vol. 46, 1914), p. 557.]

EUROPE

Balkan States. Map of the Balkan States Showing Frontiers in accordance with the Treaties and Agreements of 1913-14. 1:1,750,000. 45° - 39° N.; 18¼° - 29⅜° E. 8 colors. Accompanies ''Map of the Balkan States in Accordance with Recent Treaties,'' *Geogr. Journ.*, Vol. 43, 1914, No. 5, pp. 559-556.

[Authoritative map based on the maps of the official protocols of the Treaties of Bukharest and Constantinople, which are reproduced in the text,

and on supplementary information furnished by official sources. The critical villages whose positions define the new frontiers are shown in detail. The map does not extend farther south than the Gulfs of Arta and Volo and the island of Mytilene, and so does not show the new boundaries in the archipelago. Relief is in brown shading; railroads, in operation, under construction and projected, are differentiated.]

Denmark. Küstenänderungen im nördlichen Fünen. Entworfen von Prof. Dr. Reimer Hansen. 1:100,000. 55°39.6′ - 55°25.3′ N.; 10°2.0′ - 10°48.7′ E. 3 colors. Accompanies, as Taf. 32, "Küstenänderungen im nördlichen Fünen" by R. Hansen, *Petermanns Mitt.*, Vol. 60, I, 1914, April, p. 204.

[Shows the areas reclaimed from the sea, mainly during the nineteenth century, on the north shore of the island of Fünen.]

France. Plan du cañon du Rhône entre la perte et Génissiat. Dressé par E. A. Martel, 1910-1911. 1:20,000. [46°5′ N. and 5°12′ E.] Oriented N. 25° E. Accompanies, as Pl. 2 "La 'perte' et le cañon du Rhône" by E. A. Martel, *La Géogr.*, Vol. 29, 1914, No. 3, pp. 153-162.

[Detailed map of the well-known limestone gorge of the Rhône below its exit from Lake Geneva. The gorge is indicated by hachures; and altitudes are given to the nearest meter for those determined barometrically by M. Martel and to the nearest centimeter for those taken from the French survey. The contour of 332 meters is shown as representing the level the water would reach if the dam whose construction is under discussion were built at Génissiat, a village at the lower end of the gorge. The main roads and buildings are also shown.]

POLAR

Arctic

Arctic. Die Entdeckungen der Russischen Hydrographischen Expedition unter Führung von Fregatten-Kapitän B. A. Wilkizky im Nördlichen Eismeer im Jahre 1913. Scale of parallels 1:15,000,000. Polar cap approximately within the Arctic Circle, curtailed, however, on the side towards Greenland. 7 colors. Accompanies, as Taf. 31, "Kapt. B. A. Wilkizkis Entdeckung von Zar Nikolaus II.-Land im Nordpolarmeer" by H. Wichmann, *Petermanns Mitt.*, Vol. 60, I, 1914, April, pp. 197-198.

[Valuable map showing in detail the routes of the vessels under Capt. Vilkitsky's command on the recent expedition which led to the discovery of land north of Cape Chelyuskin, Siberia (see "Nicholas II Land" in *Bull.* for February [Vol. 46, 1914], pp. 117-120). The individual westward routes of the *Taimyr* and *Vaigatch* and their route in common eastward are differentiated in colors, and for comparison the routes of Nordenskiöld's *Vega*, Nansen's *Fram* and Baron Toll's *Sarya* and the drift of the *Jeanette* are also shown, in black. Points determined astronomically are especially indicated. Careful editing would have avoided the obsolete representation of the northeastern coast of Victoria Island, which ignores Hansen's survey during Amundsen's Northwest Passage expedition, and might also have availed itself of the information previously published in the same journal (*Petermanns Mitt.*, Vol. 57, II, 1911, p. 71) to the effect that the name of the peninsula between the Kara See and the Gulf of Obi is more properly spelled without an *l* in the first syllable, viz.: Yamal (or in the German transliteration, Jamal) instead of Yalmal.]

Antarctic

South Georgia. (Die "Bay of Isles" in Südgeorgien. Entworfen von Rob. Cushman Murphy.) 1:150,000. 53°59′ - 54°7′ S.; 37°32′ - 37°9′ W. Accompanies, on p. 280, "Die 'Bay of Isles' in Südgeorgien" by R. C. Murphy, *Petermanns Mitt.*, Vol. 60, I, 1914, May, pp. 279-280.

[Reconnaissance survey, made in Dec., 1912, and Jan. and Feb., 1913, with a pocket compass and protractor, of the largest harbor on the northeast coast of South Georgia, an individual survey of which is not included on the standard

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chart of the island, British Admiralty Chart No. 3579. In 54°2.5′ S. and 37°12′ W. we note a "Cape Woodrow Wilson."]

WORLD AND LARGER PARTS

Eurasia. Sketch Map to illustrate the papers on the Sea Route to Siberia by Dr. Fridtjof Nansen and Jonas Lied. 1:25,000,000. 90° - 30° N.; 0° - 180°. 1 color. Accompanies "The Sea Route to Siberia" by F. Nansen and J. Lied, *Geogr. Journ.*, Vol. 43, 1914, No. 5, pp. 481-500.

[Shows the route of the *Correct* (see "Record" in February *Bull.* [Vol. 46, 1914], pp. 134-135) from Stettin via Tromsö to the mouth of the Yenisei and back via Tromsö to Grimsby. Settlements are shown in greater detail along the Yenisei than for the rest of the map; the route of the Trans-Siberian railroad is also given.]

Eurasia–Africa. Schema der Bewegungsrichtungen der alpinen Deckengebirge des Mittelmeeres. Entworfen von Dr. L. Kober. 1:15,000,000. 52° -39° N.; 15° W. - 53° E. 4 colors. Accompanies, as Taf. 36, "Die Bewegungsrichtung der alpinen Deckengebirge des Mittelmeers" by L. Kober, *Petermanns Mitt.*, Vol. 60, I, 1914, May, pp. 250-256.

[Based on Suess's work and, more recently, Termier's for the western part of the region, the author divides the young folded mountains of the Mediterranean into two longitudinal belts which lie back-to-back, as it were, and whose folds have been thrust outward in opposite directions. The northern belt he designates the Alpides: its folds are thrust northward over the European foreland; the southern belt is termed the Dinarides: its folds are thrust southward over the foreland of Indo-Africa. To the Alpides belong the Betic Cordillera (Sierra Nevada, etc.), the Balearic Islands, the Pyrenees, Alps, Carpathians, Balkans, and Caucasus. To the Dinarides belong the Alps, the Apennines, the Dinaric Alps, the "Hellenides" (the continuation of the Dinaric Alps in the western half of the Balkan Peninsula) and the Taurus. For part of the distance both belts come into direct contact, as in the "Dinaric scar" of the Alps; elsewhere masses not related in structure intervene, viz., from west to east, the Moroccan meseta, the Tyrrhenian mass (Sardinia and Corsica), the "Pannonian mass" (buried under the Hungarian lowland), the Rhodope, the "Pontic mass" (interior plateau of Asia Minor) and the Armenian. These relations are exhibited on the map.]

Other Maps Received

CANADA

Canada. Geological Survey [of Canada]. Map 26A, Bathurst and Vicinity (Topography), 1:62,500, 1911; 27A, Bathurst and Vicinity (Areal Geology), 1:62,500, 1911; 45A, Tulameen, Yale District (Topography), 1:62,500, 1911; 46A, Tulameen, Yale District (Geology), 1:62,500, 1911; 65A, Coast and Islands between Strait of Georgia and Queen Charlotte Sound (Areal Geology), 1:253,440, 1913; 94A, Taku Arm, Atlin District, 5 mi. to 1 in.; 95A, Broadbock River, Mistassini Territory, 10 mi. to 1 in., 1913; 96A, Wanipigon, Manigotogan and Oiseau Rivers, 1:253,440, 1913; 100A, Bell River, 1:506,880, 1913; 103A, Southfork Coal Area, Old Man River, 2 mi. to 1 in., 1913; 104A, Thompson River Valley below Kamloop Lake, 3 mi. to 1 in., 1913; 105A, Cadwallader Creek Mining Area, Lillooet Mining Division, 2,000 ft. to 1 in., 1913; 107A, Blairmore, 2 mi. to 1 in., 1913; 108A, New Brunswick Carboniferous areas, and positions of certain shale and clay deposits, 20 mi. to 1 in., 1913. Department of Mines, Ottawa.

Maritime Provinces, etc. Map showing the number of chartered banks in New Brunswick, Nova Scotia and Prince Edward Island. 25 mi. to 1 in. Railway Lands Branch, Department of the Interior, Ottawa, 1914.

Telegraph Chart of the Gulf and Lower St. Lawrence and Maritime Provinces. Scale about 27 mi. to 1 in. Department of Marine & Fisheries, Ottawa, 1911. 15 cents.

UNITED STATES

Kansas. Fort Leavenworth war game map: Leavenworth sheet 12 in. to 1 mi. Made at Army Service Schools. Fort Leavenworth, Kansas, 1909-13.

New York. Rand, McNally & Co.'s Map of Dual Subway System. 1 in. to 1 mi. Rand, McNally & Co., New York, 1914.

Canal Map of the State of New York, to accompany the annual report of the State Engineer and Surveyor. State Engineer and Surveyor, [Albany], 1911.

Rhode Island. Map showing railroads and railways of the State of Rhode Island. Scale about 1.75 mi. to 1 in. Public Utilities Commission of Rhode Island, [Providence], 1909.

United States. Maps of United States Lighthouse Districts. (a) United States Lighthouse establishment, outline map showing districts and a few important lights. 200 miles to 1 inch. U. S. Lighthouse Board, Washington, 1909.

(b) Districts: 1st, from St. Croix River, Me., to Hampton Harbor, N. H., (inclusive), 12 mi. to 1 in.; 2nd, from Hampton Harbor, N. H., to Elisha Ledge, R. I., (not inclusive), 8 mi. to 1 in.; 3rd, from Elisha Ledge, R. I., to Shrewsbury Rocks, N. J., (inclusive), 12 mi. to 1 in.; Part of 3rd, [Lake Champlain]; 4th, from Shrewsbury Rocks, N. J. (not inclusive), to Metomkin Inlet, Va. (inclusive), 10 mi. to 1 in.; 5th, from Metomkin Inlet, Va. (not inclusive) to New River Inlet, N. C. (inclusive), 20 mi. to 1 in.; 6th, from New River Inlet, N. C. (not inclusive) to Jupiter Inlet Light-Station, Fla. (inclusive), 32 mi. to 1 in.; 7th, from Jupiter Inlet Light-Station, Fla. (not inclusive) to and including Perdido Entrance, Fla., 35 mi. to 1 in.; 8th, from Perdido Entrance (not inclusive) to the southern boundary of Texas, 35 mi. to 1 in.; 9th, [Lake Michigan], 15 mi. to 1 in.; 10th, from mouth of the St. Regis River, St. Lawrence River, to mouth of the River Rouge, Detroit River, 12 mi. to 1 in.; 11th, from mouth of the River Rouge, Detroit River, to westerly end of Lake Superior, 28 mi. to 1 in.; 12th, California from Mexican boundary to Oregon boundary, 38 mi. to 1 in.; 13th, Washington and Oregon, 28 mi. to 1 in.; 12th Subdistrict [Hawaiian Is., 25 mi. to 1 in.; Samoan Is., 20 mi. to 1 in., and Melanesia, 200 mi. to 1 in]; 14th, Tennessee and Ohio Rivers and part of Mississippi River, 20 mi. to 1 in.; 3rd Subdistrict, West Indies between the Mona and Virgin Passages, comprising Porto Rico and Dependencies, 22 mi. to 1 in.; part of 13th, [Alaska], 100 mi. to 1 in.; 15th, Mississippi River above Cairo, Missouri River to Kansas City, and Illinois River from mouth 224 miles, 18 mi. to 1 in.; 16th, [Mississippi River from New Orleans to Cairo], 18 mi. to 1 in. [With insets of important bays and harbors on each sheet]. U. S. Lighthouse Board, Washington, 1909.

SOUTH AMERICA

Argentina. Central Argentine Railway: Map of the Argentine Railways, 1913. 1:200,000. Insets: Tucuman; Cordoba; San Francisco; Santa Fé; Buenos Aires; Rosario. [Published by Central Argentine Railway, Buenos Aires]. [Gift from Mr. Ronald Falconer].

Plano de los ferrocarriles de la República Argentina, indicando la ubicación de las colonias fundadas hasta la fecha por la antigua Empresa "Colonización Stroeder." 1:2,500,000. Oficina Cartográfica de Pablo Ludwig, Buenos Aires.

Peru. Mapa general del Perú, trazado, correjido y augmentado segun mapas oficiales. 1:3,000,000. Editado por la Litografia y Tipografia Carlos Fabbri, Lima, 1909.

El Perú: mapa popular, trazado por la Sociedad Geográfica de Lima. Dibujado por Camilo Vallejos. 1:3,000,000. Carlos Fabbri, Lima, [1913].

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AFRICA

Nigeria. Africa, 1:250,000: Southern Nigeria, Sheet North C 31/V.IV. Lechilaku. Director of Surveys, Southern Nigeria, [Salisbury], 1913.

Rhodesia. North-east Rhodesia. 1:2,000,000. Topographical Section, General Staff, War Office, London, 1905. Price 2/–.

EUROPE

Austria. Geologische Karte der im Reichsrate vertretenen Königreiche und Länder der Österreichisch-Ungarischen Monarchie. 1:75,000. Zwölfte Lieferung: Blatt Iglau (K. 7.50); Wels-Kremsmünster (K. 4.50); Enns-Steyr (K. 4.50); Kirchdorf (K. 7.50). Verlag der k. k. Geologischen Reichsanstalt, Wien, 1913.

Geologische Uebersichtskarte von Böhmen, Mähren u. Schlesien, entworfen von Doc. Dr. K. Absolon und Zd. Jaroš. 1:300,000. Verlagsbuchhandlung R. Promberger, Olmütz, 1907.

Spezial-Karte der Gross-Glockner-Gruppe. 1:50,000. Bearbeitet nach den Reambulirungs-Aufnahmen des k. u. k. militär-geographischen Institutes, [Wien], 1913.

Umgebungskarte von Marienbad. 1:25,000. Buchhandlung Franz Gschihay, Marienbad, [1913].

British Isles. Liverpool Bay, surveyed by the Marine Surveyor of the Mersey Docks & Harbour Board. 5 mi. to 1 in. Mersey Docks & Harbour Board, Liverpool, 1913. Price 2/–.

Ordnance Survey of Ireland (3rd edition), Killarney District. 1:63,360. Ordnance Survey, Southampton, 1913.

Ireland [in 4 sheets]. 1:486,830. Edward Stanford, London.

France. Onésime Reclus: Atlas de la Plus Grande France. Neuvième, dixième, onzième et treizième livraisons. Attinger Frères, Paris, 1914.

Germany. Geologische Karte von Preussen und benachbarten Bundesstaaten. 1:25,000. Sheets: Lüneburg, 1912; Lauenburg, 1904. Königlich Preussische Geologische Landesanstalt, Berlin.

Geologisch-agronomisch Karte von Flensburg und Umgebung, aufgenommen von Prof. M. König und Dr. W. Wolff. 1:25,000. Königlich Geologische Landesanstalt, Berlin, 1908.

Italy. Carta politico-ammistrativa della Patria del Friuli al cadere della Repubblica Veneta. Saggio di Gian Lodovico Bertolini e Umberto Rinaldi. 1:200,000. Istituto d'Arti Grafiche, Bergamo, 1913.

Carta d'Italia del Touring Club Italiano, in 58 fogli. 1:250,000. Istituto Geografico de Agostini, Novara, [1914]. Price L. 1 ea. sheet.

[Admirable map. The engraving of relief, in brown hachures is equal to the highest standards of German cartography.]

Foci del Tavere e litorale adiacente: plano dimostrativo delle variazioni delle costa avvenute nelle diverse epoche. 1:30,000. Istituto Idrografico, 1913.

The Netherlands. Ten Brink's Groote Kaart van de Provincie Utrecht met het Gooiland en Amsterdam. 1:80,000. H. ten Brink, Meppel, [1913].

Ten Brink's Groote Kaart van de Provincie Gelderland, door J. de Regt. 1:140,000. H. ten Brink, Meppel, 1908-09. F. 1.

Sweden–Russia, etc. Philips' Timber and Mercantile Map of the Baltic. Equatorial scale, 1:2,000,000. With insets: The North Sea, equat. scale, 1:5,000,000; North European Ports, including the White Sea, equat. scale, 1:1,000,000. Geo. Philip & Son, London, [1913].